PORTLAND HARBOR RI/FS

APPENDIX B

DERIVATION OF RISK-BASED PRELIMINARY REMEDIATION GOALS

FEASIBILITY STUDY

June 2016

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B.1 BIOACCUMULATION MODELS

Bioaccumulation models were developed for calculating risk-based sediment preliminary remediation goals (PRGs) for bioaccumulative contaminants of concern (COCs) for RAOs 2 and 6.. The objective is to estimate the sediment concentration at which a defined tissue concentration would be reached. These PRGs represent a spatially weighted average concentration (SWAC) in sediment over an assumed exposure area; when the average tissue concentration in the exposure area equals the tissue threshold, the average sediment concentration for that area equals the risk-based PRG.

B1.1 DATA EVALUATION

Benthic invertebrates, sculpin, and smallmouth bass have home ranges (exposure areas) that are smaller than the Site, thus there are multiple pairs of co-located tissue and sediment chemical concentration data. These co-located datasets were evaluated to determine whether tissue concentrations were statistically related to co-located sediment concentrations.

Because of the limited number of sample collection locations and small number of samples of black crappie, brown bullhead, peamouth, largescale sucker, northern pikeminnow, and carp, an assumption regarding exposure was made that these species range across the entire Site, even though the actual home range for at least some of these species is smaller than the Site. The result is that these species lack multiple pairs of co-located sediment and tissue chemical concentration data, and it was not possible to statistically analyze whether chemical concentrations in tissue were correlated with concentration in sediment at the Site.

Co-located sediment samples were used to estimate sediment exposure concentrations for benthic invertebrates, site-wide average sediment concentrations were used to estimate exposure for wide-ranging fish species. Surface sediment SWACs were developed for exposure areas for sculpin and smallmouth bass based on the BERA dataset. Co-located sediment samples used in this analysis are presented in **Table B1-1**.

B1.1.1 Data Preparation for Benthic Invertebrates

Species used to evaluate benthic invertebrates includes worms and clams. The laboratory worms were used for the bioaccumulation model because field-collected worms were not evaluated. Laboratory worms were only exposed to Site sediment for 28 days, but because there was no better alternative for estimating bioaccumulation for worms, these data were used for bioaccumulation modeling. Since a 28-day laboratory exposure period is not sufficiently long to reach steady-state tissue concentrations for the more hydrophobic organic contaminants (such as DDT), concentrations of neutral organic COCs (butyltins, PCBs, phthalates, and pesticides) measured in laboratory worm tissue were adjusted to estimate steady-state concentrations as described in EPA and USACE (1998). Field-collected clam data were available so the data from laboratory-exposed clam were not used for bioaccumulation modeling.

Co-located data pairs with non-detected tissue or sediment concentrations were removed from the analysis per Burkhard (2006). All sediment neutral organic-chemical concentrations were normalized based on organic carbon (OC) content, tissue concentrations were normalized based on lipid content. No adjustments were made to sediment and tissue chemical concentrations for metals.

B1.1.2 Data Preparation for Small-Home-Range Species

Species used to evaluate small-home-range fish include small mouth bass and sculpin. A total of 39 composite tissue samples were analyzed for whole body sculpin and 32 composite tissue samples were analyzed for whole body smallmouth bass. Foraging ranges reported in the literature support small home ranges for sculpin, on the range of 200 ft (Hill and Grossman 1987; Natsumeda 1998, 1999, 2001; Petty and Grossman 2004; Cunjak et al. 2005). An exposure radius of approximately 0.1 mile (500 ft) was assumed to be representative of the foraging area of sculpin and their prey for a given composite sample. The resulting SWAC of the exposure area was used as the sediment concentration for the co-located sculpin composite. Natural neighbor interpolation (de Smith et al. 2008) of the BERA surface sediment dataset was used to estimate the sediment SWAC that was assigned to each composite sculpin sample. The SWACs associated with co-located sculpin tissue samples are presented in **Tables B1-2a** through **B1-2f**.

Foraging ranges and movements reported in the literature and in region-specific studies have supported home ranges for smallmouth bass that are smaller than the entire length of the Site. Pribyl et al. (2005) conducted a study in which the movement of predatory resident fish (including smallmouth bass) in the lower Willamette River were tracked. Smallmouth bass tended to stay on one side of the river once released in mid-channel. The median of the maximum distance traveled was 2.3 km (1.4 miles) from the release site, most stayed within 0.4 km (0.25 mile) of their release points in the one-month post-release period. Based on this information, the exposure reach for each composite smallmouth bass sample was assumed to be a one mile length of the river.

Because it is not known whether smallmouth bass foraged upstream or downstream from their collection point, 1-river-mile (RM) exposure areas at 0.1-mile increments were evaluated ranging from one mile upstream to one mile downstream of the collection location of each smallmouth bass in a given composite, with boundaries perpendicular to the river course. The number of 1-mile exposure areas averaged for each composite varied, up to a maximum of 10 for each collection location. The SWACs associated with each composite were then averaged. The sediment SWACs associated with co-located tissue samples are presented in **Tables B1-3a** through **B1-3f**.

B1.1.3 Data Preparation for Large-Home-Range Species

Telemetry studies (Friesen 2005; Pribyl et al. 2005) in the lower Willamette River support the assumption that black crappie, carp, largescale sucker, and brown bullhead have home ranges smaller than the Site. However, the limited tissue data and compositing scheme for these species and northern pikeminnow precluded evaluations on a smaller scale. Thus, site-wide SWACs were used for these fish species. Site-wide sediment SWACs are presented in **Table B1-4**.

B1.2 CALCULATION OF BIOTA-SEDIMENT ACCUMULATION REGRESSIONS AND FACTORS

Biota-sediment accumulation regressions and factors (BSAR/Fs) were calculated for COCs when a linear relationship between co located sediment and tissue concentrations could be established, and for which the mechanistic model could not be applied.

Three possible linear tissue-sediment models were calculated for each receptor-COC dataset with a minimum of three co-located empirical data values. Only linear models were considered because the data for the Site is generally not sufficient to consider more complex models. The following linear regressions were considered:

- Untransformed tissue concentrations vs. sediment concentrations
- Untransformed tissue concentrations vs. log-transformed sediment concentrations
- Log-transformed tissue concentrations vs. log-transformed sediment concentrations

The strength of the tissue-sediment relationship was rated as one of the following categories based on the coefficient of determination (r^2):

- No relationship: where $0.0 \leq r^2 < 0.3$
- Weak relationship: where $0.3 \leq r^2 < 0.5$
- Moderate relationship: where $0.5 \leq r^2 < 0.7$
- Strong relationship: where $0.7 \leq r^2 < 1.0$

A regression model was further considered if the slope was significantly different from zero ($p < 0.05$) and the r^2 was > 0.30. Final BSARs were selected based on the following considerations:

- Consistency of linear relationship across the range of sediment concentrations
- Distribution (homogeneity of variance and normality) of residuals around model predictions
- Outlier and influence diagnostics such as Studentized residuals; leverage; slope, intercept, fit influence measures; Cook’s distance

- The number and spatial distribution of influential data values (potential outliers)
- Possibility that influential or non-fitting data points indicate existence of separate or subpopulations
- Consistency of model type selected within a chemical class
- Logical consistency of predictions of bioaccumulation (significant intercept greater than zero indicating significant background water or prey exposure; negative intercept possibly indicating bioregulation)

B1.2.1 BSARs for Small-Home-Range Species

BSAR relationships for small home range species are presented in **Tables B1-5** through **B1-9**. If no model fit a dataset, a BSAR was not selected. The lack of a relationship between sediment and tissue concentrations might indicate that chemicals released from sediment are transported into the water column, a medium other than sediment is the source of the tissue residue, organisms are bioregulating or metabolizing the chemical, or the exposure area or use of the exposure area by organisms was not described well enough to define a relationship. All of the selected BSARs were based on log-log transformations of the sediment and tissue data. The log-log transformations were necessary to obtain reasonable spread on the independent variables in the regression analyses and improve model fit.

B1.2.2 BSAFs for Large-Home-Range Species

BSAFs were developed for black crappie, northern pikeminnow, peamouth, carp, largescale sucker, and brown bullhead as the ratio of site-wide tissue to sediment chemical concentrations. The tissue concentration was the average of available composite samples for each species, and the sediment concentration was the site-wide SWAC. BSAFs were not calculated for COCs for which BSARs were not developed for small home range species. BSAFs were developed based on ratios of sediment and tissue chemical concentrations, as appropriate. BSAFs for organic COCs were derived using Equation B1-1:

$$BSAF = \frac{(C_{tiss,LN})}{(C_{sed,OC})} \qquad \text{Equation B1-1}$$

where:

BSAF = site-specific BSAF
$C_{tiss,LN}$ = tissue concentration, lipid-normalized (mg/kg lipid dw)
$C_{sed,OC}$ = surface sediment concentration, OC-normalized (mg/kg OC dw)

BSAFs for metals were derived using Equation B1-2:

$$BSAF = \frac{(C_{tiss,ww})}{(C_{sed,dw})} \qquad \text{Equation B1-2}$$

where:

BSAF	=	site-specific BSAF
$C_{tiss,ww}$	=	tissue concentration (mg/kg ww)
$C_{sed,dw}$	=	surface sediment concentration (mg/kg dw)

BSAFs for black crappie, brown bullhead, peamouth, northern pikeminnow, sucker, and carp are present in **Table B1-10**.

When using BSARs to estimate sediment PRGs, it was necessary to apply a correction factor because the BSARs were based on linear relationships for log-log transformations of sediment and tissue data. BSAR equations were developed with the independent variable (Y) equal to the tissue concentration and the dependent variable (X) equal to the sediment concentration, as shown in Equation B1-3.

$$X = EXP\left(\frac{(ln(Y) - ln(F) - a)}{b}\right) \qquad \text{Equation B1-3}$$

where:

Y	=	independent variable
X	=	dependent variable
a	=	model intercept
b	=	model slope
F	=	correction factor

B1.3 FOOD WEB MODEL DEVELOPMENT

The Lower Willamette Group (LWG) developed a modeling approach to assist with developing sediment Preliminary Remediation Goals (PRGs) based on protection of upper trophic-level ecological receptors, and estimating risk reduction for various remedial alternatives. The model was also used to help establish appropriate sediment PRGs for RAO 2 for protection of people that may take and consume fish and shellfish from the lower Willamette River, and to assess risk reduction. The Food Web Model (FWM) is presented in detail in the Bioaccumulation Modeling Report (Windward 2015) submitted to, but not approved, by the U.S. Environmental Protection Agency (USEPA). This appendix summarized the information presented in that report. Previous draft reports can be consulted to understand how the model was chosen for Portland Harbor.

The use of a detailed mechanistic model with numerous species categories would have exceeded both the availability of site-specific and literature-derived physiological data (ODEQ 2006). Therefore, the Arnot and Gobas model (Arnot and Gobas 2004) was used to develop risk-based PRGs for the following persistent chlorinated organic COCs:

- Aldrin
- Chlordanes

- 4,4´-DDE
- Sum DDE
- Sum DDT
- Total PCBs
- 1,2,3,4,7,8-HxCDF
- 1,2,3,7,8-PeCDD
- 2,3,4,7,8-PeCDF
- 2,3,7,8-TCDD
- 2,3,7,8-TCDF

The general underlying assumptions of the model include:

- The aquatic system is in steady state with respect to bioaccumulation of hydrophobic organic chemicals.
- The flux of chemicals between water and organisms, between ingested media and organism tissue, and between different tissue types are governed by fugacity relationships.

The Arnot and Gobas model in its most general form will estimate the change in mass of chemicals in an organism over time, based on uptake of chemicals in water across respiratory surfaces (gills/integument) or, following ingestion, in water and food from the gastrointestinal tract (GI), and elimination from respiratory surfaces, in urine, and in feces. Metabolism is included as an elimination process, but has limited importance for poorly metabolized chemicals such as polychlorinated biphenyls (PCBs). For readily metabolized chemicals, such as polycyclic aromatic hydrocarbons (PAHs), metabolism may be a dominant process controlling accumulation in tissues.

B1.3.1 Food Web Model Biological Compartments

The Arnot and Gobas model was used to simulate transfer of persistent organic chemicals from surface water and sediment through a series of biological compartments represented by generic groups (such as phytoplankton), trophic levels (foraging fish), and specific species (smallmouth bass). Species compartments included in the model are:

- Phytoplankton
- Zooplankton
- Benthic infaunal filter feeders (clams, *Corbicula fluminea*)
- Benthic infaunal consumers (oligochaetes, insect larvae and amphipods)
- Epibenthic invertebrate consumers (crayfish, no species identified)

- Foraging fish (sculpin, *Cottus* sp) (Group also used to represent black crappie [*Pomoxis nigromaculatus*] and peamouth [*Mylocheilus caurinus*])
- Benthivorous fish (largescale sucker, *Catostomus macrocheilus*) (Group also used to represent brown bullhead [*Ameiurus nebulosus*])
- Omnivorous fish (common carp, *Cyprinus carpio*)
- Small piscivorous fish (smallmouth bass, *Micropterus dolomieui*)
- Large piscivorous fish (Northern Pikeminnow, *Ptycholcheilus oregonenesis*)

B1.3.2 Food Web Model Calculations – Overview

The Arnot and Gobas mechanistic model was designed around the premise that a single equation may be used to represent the exchange of non-ionic organic chemicals between an organism and its environment (Arnot and Gobas 2004). The conceptual equation which underlies the model and describes the net flux of a parent chemical being absorbed or deposited (dM_B) by an organism at any time (dt), is:

$$\frac{dM_B}{dt} = \left\{ W_B \cdot \left(k_1 \cdot \left[m_{\mathrm{O}} \cdot C_{\mathrm{WD,O}} + m_{\mathrm{P}} C_{\mathrm{WD,P}} \right] + k_{\mathrm{D}} \cdot \sum_i \left(P_i \cdot C_{\mathrm{D},i} \right) \right) \right\} - \left(k_2 + k_{\mathrm{E}} + k_{\mathrm{M}} \right) \cdot M_{\mathrm{B}} \qquad \text{Equation B1-4}$$

where:

M_B = Mass of chemical in organism (g)
W_B = Wet weight of organism (kg)
k_1 = Clearance rate constant for water ventilated by organism (L/kg×day)
m_O = Fraction of respiratory ventilation involving overlying water (unitless)
m_P = Fraction of respiratory ventilation involving porewater (unitless)
$C_{WD,O}$ = Total freely dissolved chemical concentration in overlying water (g/L)
$C_{WD,P}$ = Freely dissolved chemical concentration in porewater (g/L)
k_D = Clearance rate constant via ingestion of food and water (kg/kg×day)
P_i = Fraction of the diet composed of prey item i (unitless)
$C_{D,i}$ = Chemical concentration in prey item i (g/kg)
k_2 = Gill and skin elimination rate constant (1/day)
k_E = Fecal elimination rate constant (1/day)
K_M = Metabolic transformation rate constant (1/day)

Because of a lack of adequate time-dependent data for the Site, the model has been simplified to assume steady-state conditions. This assumption is reasonable where organisms are exposed for long periods of time, exchange kinetics are rapid relative to time of exposure, and sources of chemicals in abiotic media are stable relative to the time of exposure. Therefore, per Arnot and Gobas (2004), the equation used to assess biomagnification and bioaccumulation up the food chain becomes:

$$C_B = \frac{k_1 \times \left(m_O \times C_{WD,O} + m_P \times C_{WD,P} \right) + k_D \times \sum P_i \times C_{D,i}}{k_2 + k_E + k_G + k_M} \qquad \text{Equation B1-5}$$

where:

- C_B = Chemical concentration in biota tissue (g/kg ww)
- k_1 = Gill uptake rate constant (L/kg×day)
- m_O = Fraction of respiratory ventilation that involves overlying water (unitless)
- $C_{WD,O}$ = Total freely dissolved chemical concentration in the water column above the sediment (g/L)
- m_P = Fraction of respiratory ventilation that involves sediment-associated porewater (unitless)
- $C_{WD,P}$ = Total freely dissolved chemical concentration in the sediment associated porewater (g/L)
- K_D = Dietary uptake rate constant (kg/kg × day)
- P_i = Fraction of the diet consisting of the prey item i (unitless)
- $C_{D,I}$ = Concentration of a chemical in a prey item (g/kg)
- k_2 = Gill elimination rate constant (1/day)
- k_E = Fecal elimination rate constant (1/day)
- k_G = Growth rate constant (1/day)
- k_M = Metabolic transformation rate constant (1/day)

A number of specific models are used to define the rate coefficients and dissolved water concentrations in the steady-state equation. These models can be broken down into three categories: physical, chemical, and biological processes, and are defined in the following sections and presented in **Table B1-11**.

B1.3.2.1 Physical and Chemical Processes

Inputs from physical site-specific data and literature were used to describe various physical processes required in the model to predict chemical flux through the environment. The following parameters were calculated by the model.

$$Z_{water} = \frac{1}{HT} \qquad \text{Equation B1-6}$$

$$Z_{lipid} = Z_{water} \times K_{ow} \qquad \text{Equation B1-7}$$

$$C_{ox} = (-0.24\ T_w + 14.04) \times 0.9 \qquad \text{Equation B1-8}$$

where:

- Z_{water} = Water fugacity (mol m^{-3}/Pa)
- Z_{lipid} = Lipid fugacity (mol $m^{-3/}$Pa)
- HT = Temperature-compensated Henry's Law constant (Pa m^{-3}/mol)
- K_{ow} = Chemical-specific octanol-water partition coefficient (kg/L)
- T_w = Mean water temperature (°C)
- C_{ox} = Dissolved oxygen content at 90 percent saturation (mg/L)

Z_{lipid} is used in the calculation of chemical uptake from lipid and non- lipid organic matter (NLOM) in the gut during digestion. Z_{water} is used in the calculation of chemical uptake from water in the gut. C_{ox} is used to calculate the gill ventilation rate.

The Arnot and Gobas model calculates the fraction of dissolved and freely available chemical in the water column where such data are not available. However, because XAD column data were used in the model calibration steps, these results were adjusted to represent the dissolved concentration ($C_{WD,O}$) using Equation B1-9 (Morrison et al. 1997):

$$C_{WD,O} = \frac{filtered\ \ water\ \ concentration}{1+\left(K_{OW} \times 0.08 \times DOC\right)} \qquad \text{Equation B1-9}$$

The concentration of a chemical freely dissolved in pore water (g/L), $C_{WD,P,}$ can be estimated from the concentration of the chemical in sediment using Equation B1-10:

$$C_{WD,\ P} = \frac{C_{S,OC}}{K_{OC}} \qquad \text{Equation B1-10}$$

where $C_{S,OC}$ (g/kg organic carbon) represents the concentration of the chemical in sediment after it has been normalized for organic carbon content and K_{OC} is the organic carbon-water partition coefficient (L/kg organic carbon).

B1.3.2.2 Biological Processes

Not all species or tropic groups found in the lower Willamette River were modeled. For example, the “benthic invertebrate consumer” category represents oligochaetes, amphipods, and insect larvae.

B1.3.2.2.1 Direct Contact through Water Exposure – Phase Partitioning

Organic chemicals partition between lipids, proteins and carbohydrates (collectively known as non-lipid organic matter [NLOM]), and water. Direct contact with water during respiration for each organism was evaluated using Equation B1-11.

$$k_{BW} = \frac{k_1}{k_2} = \nu LB_{org} \times K_{OW} + \nu NB_{org} \times \beta \times K_{OW} + \nu WB_{org} \qquad \text{Equation B1-11}$$

where:

- k_{BW} = Organism-water partition coefficient
- k_1 = Gill uptake rate constant (L/kg×day)
- k_2 = Gill elimination rate constant (1/day)
- νLB_{org} = Lipid fraction of the organism (unitless)
- νNB_{org} = NLOM fraction of the organism (unitless)
- νWB_{org} = Water fraction of the organism (unitless)
- β = NLOM-octanol proportionality constant (unitless)
- K_{ow} = Chemical-specific octanol-water partition coefficient (kg/L)

When calculating k_{BW} for phytoplankton, νNB_{org} is replaced by the NLOC-octanol proportionality constant, which describes partitioning between water and non-lipid organic carbon (NLOC).

The gill uptake rate constant, k_1, describes the rate at which chemicals are absorbed from water across the membranes of the gills and skin as a function of the ventilation rate (G_v, in units of L/day) and the diffusion rate across the surface and calculated using Equation B1-12:

$$k_1 = \frac{E_W \times G_V}{W_B} \qquad \text{Equation B1-12}$$

where:

E_W	=	the chemical uptake efficiency across the gills (percent)
W_B	=	the weight of the organism (kg)
G_V	=	Gill ventilation rate

and:

$$G_V = \frac{1{,}400 \times W_B^{\ 0.65}}{C_{OX}} \qquad \text{Equation B1-13}$$

and:

C_{OX}	=	dissolved oxygen content (mg/L)
W_B	=	the weight of the organism in kg

Arnot and Gobas (2004) propose a different method of calculating k_1 for algae and macrophytes as Equation B1-14:

$$k_1 = 1/[A + (B/K_{ow})] \qquad \text{Equation B1-14}$$

where A and B are constants that represent the resistance of the algae or macrophytes to the uptake of the chemical through aqueous and organic phases, respectively. Based on empirical data described more fully in Arnot and Gobas (2004), default values of 6.0×10^{-5} and 5.5 were selected for constants A and B, respectively.

The gill elimination rate constant (k_2) describes the rate at which chemicals are removed from the organism across the gill membrane, defined as $k_2 = k_1/K_{BW}$.

Because bioaccumulation is in part dependent on the ratio of k_1 to k_2, any errors that may occur in the selection of appropriate G_V and E_W values will be canceled out in the model. Therefore, the model is relatively insensitive to errors in G_V and E_W, which makes it possible to represent the ventilation rate and chemical uptake efficiency across the gill membrane with a single equation for a variety of species.

B1.3.2.2.2 Direct Contact through Dietary Exposure – Phase Partitioning

In addition to direct exposure to chemicals in the water, organisms may also be exposed to chemicals present in ingested prey. The dietary uptake rate constant (k_D) describes gastrointestinal absorption, and is defined as $k_D = E_D \times G_D/W_B$, where E_D is the dietary chemical transfer efficiency, G_D is the feeding rate, and W_B is the weight of the organism. E_D is dependent on K_{OW}, and was defined by Arnot and Gobas based on a two-phase lipid-water resistance model as $E_D = 1/(3.0 \times 10^{-7} \times K_{ow} + 2.0)$. The first and last terms in this equation are defined as dietary uptake constants EDA and EDB, respectively. Feeding rates are best defined using site-specific empirical data, if such data are available. However, when such information is not available, the feeding rate may be defined as $G_D = 0.022 \times W_B^{0.85} \times e^{(0.06 \times T)}$ for fish, zooplankton, and aquatic invertebrate species. In the absence of empirical data, the feeding rate of aquatic filter feeders is best defined as $G_D = G_V \times C_{SS} \times \sigma$, such that the feeding rate is a product of the gill ventilation rate (G_V), the concentration of suspended solids (C_{SS} in units of kg/L), and the scavenging efficiency of particles removed from water (σ as a percentage).

Chemicals may also be eliminated from an organism in feces, and is defined as $k_E = G_F \times E_D \times K_{GB}/W_B$, where G_F is the fecal elimination rate, E_D is the dietary chemical transfer rate described above, K_{GB} is the partitioning coefficient between the gut contents of the organism and its tissue, and W_B is the organism's weight. G_F is a function of the degree to which various dietary components are digestible, as defined by Equation B1-15:

$$G_F = \{[(1-\varepsilon_L) \times \nu_{LD}] + [(1-\varepsilon_N) \times \nu_{ND}] + [(1-\varepsilon_W) \times \nu_{WD}]\} \times G_D. \qquad \text{Equation B1-15}$$

where:

ε_L	=	Dietary assimilation efficiencies of lipid (unitless)
ε_N	=	Dietary assimilation efficiencies of NLOM (unitless)
ε_W	=	Dietary assimilation efficiencies of water (unitless)
ν_{LD}	=	Lipid fraction of the diet (unitless)
ν_{ND}	=	NLOM fraction of the diet (unitless)
ν_{WD}	=	Water fraction of the diet (unitless)

Thus, $K_{GB} = (\nu_{LG} \times K_{OW} + \nu_{NG} \times \beta \times K_{OW} + \nu_{WG}) / (V_{LB} \times K_{OW} + \nu_{NB} \times \beta \times K_{OW} + \nu_{WB})$, where ν_{LG}, ν_{NG}, and ν_{WG} are the lipid, NLOM, and water contents of the gut. These gut fractions are estimated as shown below, and collectively add up to a number approaching one and are dependent upon the assimilation efficiency fraction for each component. The fractions of lipid, NLOM, and water present in the tissue of the organism are described as ν_{LB}, ν_{NB}, and ν_{WB}, respectively, and are based on organism-specific information and calculated using the following equations:

$$\nu_{LG} = \frac{([1-\varepsilon L] \times \nu_{LD})}{(1-\varepsilon L \times \nu_{LD}) + (1-\varepsilon N \times \nu_{ND}) + ([1-\varepsilon W] \times \nu_{WD})} \qquad \text{Equation B1-16}$$

$$\nu_{NG} = \frac{([1-\varepsilon N]\times \nu_{LD})}{([1-\varepsilon L]\times \nu_{LD}) + ([1-\varepsilon N]\times \nu_{ND}) + ([1-\varepsilon W]\times \nu_{WD})} \qquad \text{Equation B1-17}$$

$$\nu_{WG} = \frac{([1-\varepsilon L]\times \nu_{WD})}{([1-\varepsilon L]\times \nu_{LD}) + ([1-\varepsilon N]\times \nu_{ND}) + ([1-\varepsilon W]\times \nu_{WD})} \qquad \text{Equation B1-18}$$

In the model, Z_{water} is used to determine chemical uptake from water in the gut (ν_{WG}), and Z_{lipid} is used to determine chemical uptake from both lipid matter in the gut (ν_{LG}) and non-lipid organic matter in gut (ν_{NG}). These parameters are used in conjunction with the above equations to describe the chemical flux between an organism's tissue and the material in its gut.

B1.3.2.2.3 Growth

Growth rates may vary between and within species according to a number of factors, including, but not limited to, the organism size and age, the environmental temperature, and the availability and quality of food. Growth rate information is available for a wide range of species. The recommended approximation for growth rate in the absence of empirical data is $k_G = 0.0005 \times W_B^{-0.2}$ for temperatures around 10°C (Arnot and Gobas 2004; Thomann et al. 1992).

B1.3.2.2.4 Metabolism

Chemicals may be eliminated from an organism through metabolic transformation, in which the parent compound undergoes structural changes to become a chemical derivative or metabolite of the original compound. The metabolic process is species- and chemical-specific, and is discussed further in Section B1.3.3.14.

B1.3.3 Model Parameter Values and Distributions

For each COC modeled, a literature search was conducted from the following sources to compile possible K_{ow} values:

- EPA guidance documents for developing equilibrium sediment partitioning benchmarks (ESBs) (EPA 2008c)
- SPARC (SPARC Performs Automated Reasoning in Chemistry) online database (University of Georgia 2007)
- *Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals* (Mackay et al. 2006)

- Oak Ridge National Laboratory – Risk Assessment Information System (RAIS) (RAIS 2008)
- Agency for Toxic Substances and Disease Registry (ATSDR) ToxFAQs (ATSDR 2008)
- EPA's KowWIN software (EPA 2007)

Parameter distributions for input into the model were based on empirical data whenever possible and were intended to reflect the uncertainty surrounding estimates of central tendency. According to the central limit theorem, the distribution of estimates of the mean approaches a normal distribution with sufficient sample size, and the standard deviation of the distribution of estimates of the mean is defined by the standard error of the original data. The following standardized approach was used to develop parameter estimates for the distributions of central tendency.

1. When site-specific data were available, estimates of the mean were defined by a normal distribution with a mean equal to the mean of the empirical data and a standard deviation equal to the standard error of the empirical data.

2. If there were no site-specific data, but literature values for the mean and standard deviation were available, the literature mean and standard deviation were used to define a normal distribution that would provide a conservative bounding of the distribution of mean estimates.

3. For all chemicals or chemical groups modeled, a uniform distribution was assigned for log Kow for a given chemical group. The nominal value was defined as the most appropriate Kow based on the literature reviewed. The range was defined as minimum-to-maximum literature Kow values.

For all other parameters with insufficient data to define a distribution (mean and standard deviation or standard error), a triangle or uniform distribution was assigned (MacIntosh et al. 1994). The nominal value was defined as the mean of the data if the data were considered sufficiently relevant and comprehensive. For more uncertain data, the nominal value was based on the consideration of published selections for parameter values used in other mechanistic models and best professional judgment. The minimum and maximum values were defined by the literature values if they were considered sufficient to bound a plausible range.

B1.3.3.1 Water Concentration

Chemical concentrations in the water column were calculated using XAD water column samples collected during the seven sampling events at five transect locations, and are presented in **Table B1-12a**.

Because of the high frequency of non-detects in surface water samples for dioxin/furan congeners, the method used to estimate surface water concentrations was modified. Two approaches were evaluated. Weighted-average values were calculated using one-half the detection limit for non-detected values, rather than excluding those samples as was done for the other chemicals. A second weighted-average water concentration was calculated such that if no detected values were available, one-half the lowest detection limit was used as the average. Surface water concentrations for dioxin/furan congeners are presented in **Table B1-12b**. In addition, the samples collected during the storm event[1] were excluded in order to evaluate the potential impact of these samples on the estimated overall average water. This option was used only for those congeners with detection frequencies of less than 50 percent.

B1.3.3.2 Sediment Concentration

A site-wide SWAC was calculated for each of the modeled COCs using the natural neighbors approach for site-wide exposure estimates (**Table B1-4**). The site-wide SWAC was assumed to represent the average sediment exposure condition for the sampled organisms. This could be a source of error for small-home-range species collected from areas of known or suspected sediment contamination (for example, crayfish) because the Study Area-wide SWAC might underestimate the average sediment exposure condition for the sampled organisms. Sediment chemical concentration was defined as a decision variable developing PRGs using the model, consistent with Morgan and Henrion (1990), who state that sediment chemical concentrations should be treated parametrically because they are decision variables. In this instance, “treated parametrically” means that the SWAC should not be used as a calibration parameter. This is a potential source of error for small-home-range species collected from areas of known or suspected sediment contamination, because the site-wide SWAC might underestimate the average sediment exposure condition for the sampled organisms. However, uncertainties surrounding estimates of the SWAC would also apply to alternative conditions (such as PRGs) provided they all are calculated consistently. This does not mean that sediment concentration uncertainty can be ignored, but it reduces the importance of this uncertainty in the model.

B1.3.3.3 Octanol-Water Partition Coefficient (Kow)

For each chemical that was modeled, the literature was searched to compile possible K_{ow} values. Uniform distributions were used when calibrating the model, defined by a nominal value and a minimum and maximum from the literature sources. K_{ow} values for chemical mixtures (total PCBs and DDx) were weighted based on the percent contribution of the individual components in tissue samples before selecting distribution values. Nominal and uniform distribution values for individual chemicals are shown in **Table B1-13a,** and for chemical mixtures in **Table B1-13b**.

[1] Of the seven events during which water samples were collected, one of these was considered a storm event.

B1.3.3.4 Weight, Lipid Fraction, and Water Content

Weight, lipid fraction, and water content data were derived from site-specific data for most organisms. These data were not available for phytoplankton/algae, zooplankton, and worms, thus literature values were identified for these parameters.

B1.3.3.5 Phytoplankton/Algae

Weight data for phytoplankton/algae were not required by the model. The lipid fraction and water content fraction values for phytoplankton/algae were calculated from Mackintosh et al. (2004). The values presented in this study are an aggregate of brown algae, green algae, and phytoplankton/algae collected from a tow net. A triangle distribution was assigned for the lipid fraction with a nominal value of 0.00123 and minimum and maximum of 0.0008 and 0.002, respectively. The water content fraction was calculated by subtracting the reported NLOC fraction (nominal value of 0.0433 and minimum and maximum of 0.006 and 0.063, respectively) and lipid fractions from 1. This estimate of water content does not include consideration of constituents other than lipids, carbon, and moisture because they were not available. A triangle distribution was also assigned for water content fraction with a nominal value of 0.955 and a minimum and maximum of 0.935 and 0.993, respectively.

B1.3.3.6 Zooplankton

The average weight of zooplankton was estimated from Giles and Cordell (1998). Assuming 90 percent moisture content, a triangle distribution was assigned with a nominal value of 1.4×10^{-7} kg, with and a minimum and maximum of 3.3×10^{-8} and 2.3×10^{-7} kg, respectively, reflecting the range presented in Giles and Cordell. The lipid fraction was calculated from Evjemo and Olsen (1997), again assuming a moisture content of 90 percent, a triangle distribution was assigned with a nominal value of 0.01 and a minimum and maximum of 0.009 and 0.011, respectively. Moisture content was assigned a triangle distribution with a mean of 0.9 (Kuroshima et al. 1987) [as cited in Delbare et al. (1996)]and a minimum and maximum of 0.80 and 0.98, respectively, as determined using best professional judgment.

B1.3.3.7 Invertebrates

Site-specific data were available for benthic invertebrate filter feeders (clams) and epibenthic invertebrate consumers (crayfish). Values for benthic invertebrate consumers (worms, amphipods, midges, etc.), were assigned based on literature and best professional judgment. Weight data for three detrital/deposit feeding species (*Chironomus riparius, Limnodrilus hoffmeisteri,* and *Corophium voluntator*) were examined (Kraaij et al. 2001; Millward et al. 2001; Bervoets et al. 2003) and used to define a triangle distribution. The lipid fraction for this trophic group was also evaluated using literature data on several different species (*Corphium* spp., *Nereis vexillosa,* and *Chironomus* spp.) (Weston et al. 2002; Kraaij et al. 2001; Lyytikäinen et al. 2003). In addition, information on lipid content collected prior to exposure for bioaccumulation tests was considered. These studies used worm species found in the lower Willamette River (*Lumbriculus* spp.) (Windward and Integral 2005). Weight, lipid, and water-fraction content for invertebrates is summarized in **Table B1-14a**.

B1.3.3.8 Fish Species

Site-specific data were available for all modeled fish species, which included sculpin, largescale sucker, carp, smallmouth bass, and northern pikeminnow. Weight, lipid fraction, and water content fraction data were calculated using data from the project database. Weight, lipid, and water-fraction content for fish is summarized in **Table B1-14b**.

B1.3.3.9 Dietary Absorption Efficiencies

Dietary absorption efficiencies of lipids, NLOM, and water were generally taken from Arnot and Gobas (2004) because site-specific data were not available for these parameters. No distributions were used for lipid and NLOM dietary absorption efficiencies. Additionally, no distribution was assigned to dietary absorption of water inasmuch as the model is not sensitive to this parameter because water is not a significant reservoir for hydrophobic organics compared to lipid and NLOM (Arnot and Gobas 2004). This information is summarized in **Table B1-15**.

B1.3.3.10 Pore Water Ventilation

The fraction of pore water ventilated by each species was determined by best professional judgment, and is presented in **Table B1-16**.

B1.3.3.11 Growth Rate Constant

Growth rate information is available for a wide range of species. Growth rates may vary between and within species according to a number of factors, including, but not limited to, the organism size and age, the environmental temperature, and the availability and quality of food. The recommended approximation for growth rate in the absence of empirical data is $k_G = 0.0005 \times W_B^{-0.2}$ for temperatures around 10°C (Arnot and Gobas 2004; Thomann et al. 1992). However, as no weight data were required for phytoplankton/algae, the growth rate constant was assigned a triangular distribution with a nominal value of 0.08 per day, with a minimum and maximum, respectively of 0.03 and 0.13 per day (Arnot and Gobas 2004).

B1.3.3.12 Scavenging Efficiency (Filter Feeders Only)

Scavenging efficiency is required for only benthic invertebrate filter feeders (clams). A value of 1.0 was derived from Morrison et al. (1996, as cited in Arnot and Gobas 2004), Reeders et al. (1989), and Ten Winkel and Davids (1982). No distribution was developed for this parameter.

B1.3.3.13 Dietary Assumptions

The diets of each modeled species were developed by conducting literature reviews and interviewing fish biologists in order to best reflect the diets of each species. However, because of the limited number of species that were modeled, dietary consumption described in the literature of species not included in the model had to be reassigned to other species using best professional judgment. Thus, most diets are necessarily simplified. For example, sculpin are known to eat juvenile fish, but this category was not included, although sculpin were used to represent juvenile fish for other fish species. Because cannibalism and eating fish designated as higher up in the food web are not possible in the model, sculpin cannibalism and sculpin consumption of juvenile fish were represented by the consumption categories of benthic invertebrate consumer and benthic invertebrate filter feeder. These surrogate selections were based primarily on a consideration of life history and lipid content in the previously modeled juvenile fish (Windward 2005) and the three invertebrates.

The dietary menu selected for the benthic invertebrate consumer trophic group reflects the dietary preferences of all three of those species. Dietary compositions for fish and invertebrates were compiled primarily from ODFW 2005 and general qualitative observations of fish stomach contents collected during Round 1 sampling (Integral et al. 2004). These stomach content analysis results were augmented with data from the general literature, including a study of dietary habits of lower Columbia River fish (Zimmerman 1999).

Diets of fish and invertebrates vary because of opportunistic feeding behavior and seasonal and spatial variations in prey availability. The presence of natural fluctuations in dietary preferences was addressed by normalizing dietary fractions across a menu of possible food items. This normalization was accomplished using a matrix spreadsheet provided by ODEQ (2006). When the model is run deterministically, each trophic group is assigned one best estimate of dietary items and portion of each dietary item. When the model is run probabilistically, the portion of each dietary item consumed varies with each model iteration. The matrix ensures that the selected portions are normalized so the sum of dietary portion equals one. Dietary assumptions are presented in **Table B1-17**.

B1.3.3.14 Metabolic Rate Constant

Chemical-specific metabolism, or biotransformation, of some chemicals explains why they are not bioaccumulated in the tissues of higher trophic level organisms to the extent that would be predicted. A review of literature regarding K_M's indicates that some members of the chemical classes being modeled are likely metabolized (Niimi 1996; Sijm et al. 1993; Opperhuizen and Sijm 1990; Konwick et al. 2006). K_M's for chemicals identified as being metabolized to a significant extent are presented in **Table B1-18**. A uniform distribution was used for model calibration, with values based on Arnot et al. (2008). For chemicals not listed in this table, no metabolism was assumed in the mechanistic model.

B1.3.4 MODEL CALIBRATION

Due to the complexity of the Arnot and Gobas model and the number of plausible inputs, values, the model was calibrated using site-specific data where possible in a series of iterative steps. This process was performed in two steps. First, the model was calibrated for non-chemical-specific parameters applicable to all chemicals. Then for each chemical, the model was further calibrated for chemical-specific parameters (such as Kow, chemical concentration in water, and KM). Calibration was performed by selecting the input parameter values from initial parameter distributions that produced the best estimate of the smallmouth bass empirical tissue concentration while also closely predicting the empirical tissue concentrations of the other modeled species. Empirical tissue concentrations for invertebrates and vertebrates, respectively, for modeled chemicals that were used to calculate SPAFs are presented in **Tables B1-19** and **B1-20**.

Numerous inputs in the model are not chemical-specific (for example, lipid content of zooplankton). Accurate values for parameters common to all chemicals (non-chemical-specific parameters) were selected so that the model would perform well for a range of COCs. The non-chemical-specific values that were calibrated in this step include:

- General environmental values: water temperature, total suspended solids in water, dissolved OC concentration in water, and OC content of sediment
- Species-specific biological and dietary values: weight, lipid content, moisture content, fraction of pore water ventilated, growth rate constant, and dietary consumption fractions

In all, 21 parameters were not calibrated. These include uptake constant EDA and EDB, the non-lipid organic matter (NLOM)-proportionality constant, and the species-specific dietary absorption efficiencies of lipid and NLOM. The model is generally not sensitive to these parameters,[2] and thus they were not critical to refining model performance.

Model calibration was initially performed using chemicals with a range of K_{OW} values. Total PCBs were selected because the large dataset helped ensure that the model would be accurately calibrated for this COC. To the extent that this improved the calibration of non-chemical-specific parameters, it also improved the calibration for other chemicals. Five additional chemicals (4,4′-DDE, DDx, PCB 17, PCB 118, and PCB 167) with K_{ow} values ranging from 5.70 to 7.48 were then used to verify the model. The selection of both individual chemicals and chemical mixtures helped to ensure that the model would be calibrated to perform well for a variety of chemicals. Several criteria were used to select the calibration chemicals:

- COCs that represented a range of K_{ow} values were chosen so that model performance could be evaluated across the spectrum of K_{ow} values, as the model is sensitive to K_{ow} (Arnot and Gobas 2004).

[2] The one exception to this statement is the dietary absorption efficiency of lipids for epibenthic invertebrate consumers (EIC [crayfish]) had a large effect on the predicted EIC tissue concentration.

- COCs with a high frequency of detection in sediment, water, and tissue were chosen.
- PCB congeners that did not co-elute during chemical analysis were chosen because co-elution makes it difficult to interpret concentration data.
- COCs that were not significantly metabolized were selected to minimize the impact of uncertain metabolic rates on model calibration.

After initial model calibration for non-chemical-specific parameters, chemical-specific parameters were calibrated for each chemical for which PRGs were needed.

B1.3.4.1 Model Performance Metrics

A species predictive accuracy factor (SPAF) was used as the primary evaluation metric of model performance. The SPAF can be calculated in one of two ways: if the model is over-predicting, such that the predicted value is greater than the empirical value, then the SPAF is calculated by dividing the predicted value by the empirical value, or if the model is under-predicting, the SPAF is calculated by dividing the empirical value by the predicted value. Thus the SPAF is always a positive value greater than 1.

$$\text{SPAF} = \text{predicted/empirical or SPAF} = \text{empirical/predicted} \qquad \text{Equation B-19}$$

A performance goal of predictive capability within a factor of 10 (average of all modeled groups) was considered the minimum model performance, and an average factor of 3 was identified as a target. By definition, a SPAF of 1 demonstrates that the model is exactly predicting the empirical data.

B1.3.4.1.1 Calibration of Non-Chemical-Specific Parameters

The calibration of the model for non-chemical-specific parameters was performed first, using all available data. Model calibration was performed through probabilistic analysis. The model for total PCBs was selected for initial calibration, and was run 50,000 times using Monte Carlo simulation (using Crystal Ball® software) with different combinations of plausible values for all non-chemical-specific model input parameters, selecting the input values from initial distributions that produced the best estimate of smallmouth bass empirical tissue concentration, while also closely predicting the empirical tissue concentrations of the other modeled species.

A screening step was performed on the 50,000 iterations to eliminate runs for which the invertebrate and fish dietary percentages fell outside of the acceptable ranges. This step was necessary because for each model run, the sum of the randomly selected dietary fractions was normalized to equal 1 (100 percent), meaning that it was possible to generate dietary fractions outside of the initial specified ranges. Eliminating runs for which parameters fell outside of the acceptable ranges was done to ensure that the calibrated model includes realistic dietary assumptions for each modeled trophic group.

The best performing model run, defined as having the lowest SPAF, particularly for smallmouth bass and a plausible set of inputs was identified. The values for non-chemical-specific parameters (all parameters except K_{ow}, K_M, sediment and water concentrations) were entered into the model and tested using the other calibration chemicals. After confirming that these parameters performed well (SPAFs < 5) for other chemicals with a range of K_{ow}'s, these calibrated parameter values were applied to the models for all other modeled chemicals. Probabilistic analysis was again used to select the values for chemical-specific parameters (K_{ow}, chemical concentration in water, and K_M's) associated with the best model performance site-wide.

The remaining acceptable model runs (n = 9,982) were filtered based on the SPAF for modeled fish and invertebrate species:

- Model runs with SPAFs greater than 1.5 for smallmouth bass were discarded (842 model runs remained).
- Model runs with SPAFs greater than 5 for carp were discarded (168 model runs remained).[3]
- Model runs with SPAFs greater than 2 for other fish species (sculpin, largescale sucker, and northern pikeminnow) were discarded (61 model runs remained).
- Model runs with SPAFs greater than 5 for invertebrates (BIF and EIC) were discarded (25 model runs remained).

The remaining 25 qualifying model runs were selected for additional analysis. The result of this calibration process was a model that is highly accurate for smallmouth bass while still predicting well for other modeled species.

The non-chemical-specific input values from these top 25 model runs were then used to evaluate the model's ability to predict smallmouth bass tissue concentrations on a smaller spatial scale (using 1-RM SWACs) for total PCBs. This evaluation was done using the non-chemical-specific parameters from the top 25 model runs and nominal values for chemical-specific parameters (K_{ow} and chemical concentration in water) were used along with estimates of sediment concentrations for each bass composite sample to estimate smallmouth bass tissue concentrations for individual composites. SPAFs were then calculated for each composite sample, and an average SPAF across the individual composite samples was calculated for each of the 25 parameter sets. Before selecting the top model runs, consideration was also given to key input values. The range of mean surface water temperature values based on the available empirical data was determined to likely be outside of the range of reasonable values. Thus, parameter sets with water temperatures more than 1º C off of the average empirical value of 13.9º C (<12.9 or

[3] The SPAF for carp was higher than that for other fish species for total PCBs because of the presence of two high values in the dataset. When these values were excluded, the carp SPAFs for the selected 25 model runs were all less than 2.

>14.9 ºC) were excluded from consideration. Of the remaining 10 parameter sets, the best four model runs (sorted based on the SPAF for smallmouth bass) were carried forward to the next step.

To further evaluate the four selected model runs, these parameter sets were evaluated for the other five calibration chemicals (PCB 17, PCB 118, PCB 167, 4,4´-DDE, and DDx). As with total PCBs, these model runs were evaluated both on a site-wide basis and on a smaller spatial scale for smallmouth bass. For this evaluation, nominal values were used for chemical-specific parameters (K_{ow}, chemical concentration in sediment, and chemical concentration in water).[4]

Empirical invertebrate and fish tissue data for each calibration chemical were compared with the model-predicted tissue concentrations, using both the uncalibrated and calibrated non-chemical-specific parameters to ensure that calibration had improved model performance. The final calibrated parameter set was identified based on the following:

- **Site-wide model performance –** Model runs were sorted based on the average SPAF for the seven species across the five calibration chemicals on a site-wide basis.
- **Smallmouth bass smaller-spatial-scale model performance –** Model runs were sorted based on the average SPAF across smallmouth bass composite samples and across the five calibration chemicals.

The same model run was identified using both of the above metrics, and thus the parameter set associated with this model run was selected. These parameter values were then accepted as final calibrated values for the non-chemical-specific parameters. SPAFs for each of the calibration chemicals using the initial uncalibrated input values (the nominal value of the distributions) and the calibrated values are presented in **Table B1-21**.

Additionally, to evaluate the model on a smaller spatial scale, the model performance for individual smallmouth bass samples was examined, as shown in **Table B1-22**. The use of the calibrated parameter set for the non-chemical-specific parameters in the model improved the average SPAF across smallmouth bass composites using the mean, minimum, or maximum SWAC. Additionally, in all cases the number of samples with SPAFs < 5 and those < 10 increased when the calibrated parameter set was used. Based on this analysis, the model was determined to be fully calibrated for non-chemical-specific parameters.

The original distributions as well as the selected calibrated values for non-chemical-specific parameters are presented in **Table B1-23** (environmental parameters), **Table B1-24** (general biological parameters), **Table B1-25** (species-specific biological parameters), and **Table B1-26** (dietary parameters).

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[4]The selected calibration chemicals are not thought to be metabolized to a significant extent. The selection of non-metabolized chemicals was intentional to ensure that model calibration was not impacted by metabolism.

B1.3.4.1.2 Calibration of Chemical-Specific Parameters

Once the non-chemical-specific parameters had been calibrated, the model was again calibrated for K_{ow}, water concentration, and K_M. As with the non-chemical-specific input calibration, the sediment concentration (site-wide SWAC) was held as a constant.

Chemical-specific calibration was done in two steps. The first step established a calibrated value for K_{ow} and chemical concentration in water. The second step was to determine a calibrated value for the K_M for chemicals known to be metabolized. This two-step calibration process was done to ensure that the K_M calibration did not influence the calibration of K_{ow} or water concentration. Calibrated values for all non-chemical-specific parameters were entered into the model for each chemical, the, and distributions were defined for the chemical's K_{ow} and concentration in water.

Initially, a nominal value for K_M was entered with no distribution was defined to ensure that the metabolic rate did not influence the calibration of K_{ow} and water concentration. The model was then run 1,000 times for each chemical, and the output was sorted based on the SPAFs for smallmouth bass. Other considerations for selecting a calibrated value for the K_{ow} and chemical concentration included the following:

- SPAFs for smallmouth bass were <2, and the percent difference for smallmouth bass was considered to ensure that the model was not under-predicting concentrations for this important species.
- SPAFs for other fish species were considered, and model runs were also sorted to optimize model performance for these species (SPAFs generally <3).

The result of this calibration process was the selection of K_{ow} values and chemical concentrations in water that improved the model performance for smallmouth bass and other species.

The second step was conducted only for chemicals known to be metabolized and included the calibrated K_{ow} and water concentration. Uniform distributions (representing uncertainty ranges) were defined for the K_M's, and the model was again run 1,000 times for each chemical, with the output evaluated using the same criteria described in Step 1. The calibrated K_M's were selected to improve model performance for smallmouth bass (SPAFs <1.5) while also improving model performance for the other species (SPAFs generally <3). With all parameters calibrated, the minimum acceptable model performance was a SPAF of ≤3 for smallmouth bass, and a SPAF of ≤10 for all other species-chemical combinations. Calibrated values for K_{ow} and concentration in water are presented in **Table B1-27**, calibrated K_M values are presented in **Table B1-28**.

B1.3.5 Calibrated Model Performance

After all non-chemical specific and chemical-specific model parameters were calibrated, model performance was evaluated both on a site-wide basis and on smaller spatial scales for smallmouth bass and sculpin. The following subsections present this evaluation of model performance.

B1.3.5.1 Site-Wide Spatial Scale

As discussed previously, model calibration emphasized model performance for smallmouth bass. All SPAFs for smallmouth bass are <2, and SPAFs for other species are generally <3. With four exceptions, all species-chemical combinations have SPAFs of <5. These exceptions are discussed below:

- 4,4′-DDD for benthic invertebrate filter feeders – Model under-predicting by a large margin because of several high concentrations that inflate the site-wide average.
- Sum DDD for benthic invertebrate filter feeders – Model under-predicting by a large margin because of several high concentrations that inflate the site-wide average.
- Aldrin for sculpin – Model under-predicting by a factor of 6 because of high Round 1 reporting limits. Removing these 26 reporting limits from the dataset (of the 38 samples) causes the model to over-predict by a factor of 13. This indicates that the available data with detected concentrations (n=12) do not provide a comprehensive site-wide dataset, and model performance should not be evaluated.
- Alpha-hexachlorocyclohexane (HCH) for sculpin – Model over-predicting by a factor of 8.1 when the 26 samples with high Round 1 reporting limits are removed. If these data are included, the model under-predicts by a factor of 7.6. The high over- and under-prediction of the sculpin data by the model indicates that this dataset does not represent the site-wide average, and model performance should not be evaluated.

The calibrated model performance is presented in **Table B1-29**. There is no pattern of significant over- or under-prediction by species or chemical, indicating good overall model performance on a site-wide basis.

B1.3.5.2 Model Predictions Compared to Individual Sample Data

To further evaluate model performance, model-predicted tissue concentrations were graphed along with the full empirical tissue dataset for each species and the empirical mean and medians of the empirical data. Note that the following abbreviations are used in the graphs for ease of presentation:

- BIF – benthic invertebrate filter feeders (clams)
- BIC – benthic invertebrate consumers (worms)
- EIC – epibenthic invertebrate consumer (crayfish)
- SCL – sculpin
- LSS – largescale sucker
- CAR – carp

- SMB – smallmouth bass
- NPM – northern pikeminnow

Results of calibrated model predictions compared to empirical data for modeled chemicals are presented in **Figures B1-1** through **B1-20**. Field-collected empirical data are available for all species or species groups with the exception of benthic invertebrate consumers (only laboratory bioaccumulation test data are available for this species). Additionally, empirical data are not presented on the graphs for some chemical-species combinations because tissue was not analyzed for those combinations, or because the dataset available for this species was considered insufficient to represent site-wide conditions.[5] The majority of the model-predicted tissue concentrations are similar to the average empirical tissue concentration and are within the range of empirical data collected from the lower Willamette River.

B1.3.5.3 Smaller Spatial Scale Model Application for Smallmouth Bass

The calibrated model was also evaluated on smaller spatial scales for smallmouth bass. The mean SWAC for each composite was used in the model to predict the tissue concentration, and the minimum and maximum 1-mile SWACs were used to provide a range on the sediment concentration to which the smallmouth bass in the composite may have been exposed. In Swan Island Lagoon, no ranges of sediment exposure concentrations were available, and thus no error bars could be calculated for the bass composites. Because it is likely that bass and some of their prey leave the lagoon, they would be exposed to some degree to sediment concentrations similar to those experienced by the fish in RM 8 or RM 9. Model predictions and empirical data for individual bass composites by location for selected PCBs, dioxin/furans, and DDx are presented on **Figures B1-21** to **B1-34**. Predicted and empirical tissue concentrations are on a wet-weight basis, while sediment concentrations are on a dry-weight basis.

The model generally predicts the empirical data within a factor of 3 based on the mean SWAC for each composite. Locations where the model does not predict as well based on the mean sediment SWAC are generally areas with high variability in the sediment and thus a high level of uncertainty in the sediment concentration to which the bass in a given composite were exposed. The uncertainty about these model predictions are represented by error bars calculated based on the minimum and maximum 1-RM SWACs that could be applicable to a given bass. These error bars generally overlap the empirical data for the smallmouth bass composite samples, further indicating that the model is predicting well on a smaller spatial scale.

For purposes of this assessment, smallmouth bass collected inside of Swan Island Lagoon and their prey were assumed not leave this area. Only a single sediment SWAC was calculated, and thus no range of sediment concentrations is available to bound the

[5] Round 1 pesticide data for some species consisted of mostly high non-detect values. For datasets where these data significantly impacted site-wide mean, the high Round 1 non-detect data were excluded from the dataset compared to mechanistic modeling predictions, as noted in Table 5-14.

uncertainty regarding the sediment concentration to which bass are exposed. Because of the variability in the sediment PCB concentrations in Swan Island Lagoon and on the east side of RM 8 and RM 9, the model over-predicts bass tissue PCB concentrations in Swan Island Lagoon, perhaps because the bass collected from Swan Island Lagoon (where sediment concentrations are higher) and their prey were also exposed to the lower sediment concentration in RM 8 and RM 9.

B1.3.5.4 Smaller Spatial Scale Model Application for Sculpin

The calibrated mechanistic model was also evaluated on smaller spatial scales for sculpin. As described previously, sculpin exposure areas were based on a circle with a radius of 0.1 mile. Model prediction versus empirical data for individual sculpin composites by location are shown on **Figures B1-35 to B1-48**. The model generally predicted within a factor of 3 compared to the empirical sculpin data based on the mean 0.1-mile-radius SWAC.

The percent contribution of water to model-predicted tissue concentrations varies by chemical and species, these results are presented in **Table B1-30**. Factors influencing the percent contribution from water include:

- Chemical concentration in filtered water relative to the chemical concentration in sediment
- Chemical-specific K_{ow}
- Species-specific fraction of pore water ventilated (contribution from pore water is part of the percent contribution from sediment)

When chemical concentrations in sediment are relatively low compared to filtered water concentrations, water contribution is more important for all modeled species. Assuming a similar relationship between the chemical concentration in sediment and filtered water, the importance of water contribution increases as the K_{ow} value decreases.

B1.3.6 Application of the Model for Other Tissue Data

Rather than modeling all species, trophic groups were modeled, with a single species used to represent each trophic group. By using representative species to model an entire trophic group, uncertainties are introduced into model predictions for those species that are not directly modeled. Peamouth and black crappie were modeled as foraging fish (represented by sculpin) and brown bullhead were modeled as benthivorous fish (represented by largescale sucker). A comparison of empirical and modeled tissue concentrations for these species are presented in **Tables B1-31** and **B1-32**. A comparison of empirical versus predicted results was not possible for brown bullhead (as represented by largescale sucker) or peamouth because no dioxin/furan data were available for these species.

B2.0 BASIS FOR PRGS BASED ON DIOXIN/FURAN CONGENERS

This section presents the process used to develop congener-specific dioxin/furan PRGs. The RI report evaluated total PCDD/F and PCDD/F TEQ in sediment. Not all dioxin/furan congeners express equal toxicity, and their toxicity can be expressed in terms of TEQ relative to 2,3,7,8-TCDD. Further, the TEQ should only be applied at the point of exposure, which for both human health and ecological exposures includes a dietary component in addition to direct exposure to sediment. However, bioaccumulation from sediment through the food chain is affected by many factors, including physical-chemical properties such as the octanol-water partitioning coefficient (K_{ow}), organic carbon content of sediment, and the chemical-specific rate of metabolism by various species. When evaluating dietary exposures, it would only be appropriate to evaluate TEQ in sediment if there was a direct relationship between it and TEQ in fish.

The following process was conducted to evaluate dioxin/furans for development of risk-based preliminary remediation goals (PRGs):

1. Determine the specific congeners that pose the majority of estimated risks via consumption of fish on a river mile basis using smallmouth bass (SMB) whole body data collected during Round 3.

2. Determine if there is a relationship in fish and sediment TEQ.

3. Calibrate the Portland Harbor Arnot and Gobas food web model for each congener identified in Step 1, then use the model as intended to calculate sediment PRGs. The calibration of the FWM for dioxin/furan congeners is discussed in Section B1.

4. Map congener-specific PRG concentrations in surface sediment to determine if PRGs overlap or are located in unique areas and determine if congeners can be summed or remain independent.

5. Develop background concentrations for each congener.

B2.1 DETERMINE WHICH CONGENERS POSE THE MAJORITY OF RISK FROM FISH TISSUE

The Round 3 smallmouth bass whole body data set, which was the only data set available that provides resolution of a river mile scale[6], were reviewed to determine if there was variation in the congener patterns in tissue throughout the Site. Five specific congeners were identified as posing between 85 and 95 percent of the risk by converting reported tissue concentrations to 2,3,7,8-TCDD equivalent concentrations using toxicity equivalency factors as presented in USEPA 2010. **Table B2-1** provides a summary of the SMB data used and analysis conducted. The following five congeners were found to

[6] No tissue dioxin/furan data in smallmouth bass are available in Swan Island Lagoon.

contribute greater than 85 percent of the estimated cancer risk and non-cancer hazard associated with fish consumption:

- 1,2,3,4,7,8-HxCDF
- 1,2,3,7,8-PeCDD
- 2,3,4,7,8-PeCDF
- 2,3,7,8-TCDD
- 2,3,7,8-TCDF

B2.2 SEDIMENT-TISSUE RELATIONSHIP

A review of the dioxin/furan congener data in sediment was compared to tissue results to determine if there was a relationship between TEQ in fish and in sediment. This evaluation is presented in **Table B2-2**. Congeners contributing to the majority of the total PCDD/F sediment concentration (1,2,3,4,6,7,8-Heptachlorodibenzofuran, 1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin, and 1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin) are not the congeners posing the majority of risk from fish tissue. A comparison of the total PCDD/F concentrations to the predicted SMB TEQs are presented on **Figure B2-1**. It appears that two samples at RM 7 are driving this relationship, when these results are not considered in the analysis, it appears that there is no relationship between tissue and sediment concentrations, as presented on **Figure B2-2**. Therefore, total PCDD/F PRGs in sediment concentrations would not be protective for the Site. The data used to conduct this analysis is provided in **Table B2-3**.

A comparison of predicted sediment-based TEQ to the predicted tissue-based TEQ was also conducted. The congeners contributing to the sediment-based TEQ pattern is very different from those contributing to the tissue-based TEQ pattern as presented in **Table B2-2**.

B2.3 MAP CONGENER-SPECIFIC PRG CONCENTRATIONS IN SURFACE SEDIMENT

Figures B2-3 through **B2-7** were prepared showing the distribution of contamination in surface sediment for each of the five congeners. These figures were reviewed to compare the cumulative footprints of the five congeners to determine if they were co-located. As the congener-specific footprints were found to vary spatially within the Site, EPA determined that that the remedial footprint should be determined as the area encompassed by the cumulative footprint of the individual congeners.

B2.4 BACKGROUND VALUES FOR INDIVIDUAL DIOXIN/FURAN CONGENERS

Background values for individual dioxin/furan congeners were evaluated consistent with the approach described in Section 7 of the RI report. As with the RI, results in the background data set analyzed using Method SOM01.2 were excluded from the analysis. All results were non-detect, and the detection limits displayed a consistent pattern of high detection limits relative to the detected results. With the remaining data, the frequency of detection was less than 50 percent for 1,2,3,7,8-PeCDD, 2,3,4,7,8-PeCDF, 2,3,7,8-TCDD, 2,3,7,8-TCDF. It was not considered appropriate to calculate UCLs and UPLs on data with such low frequency of detection, thus, background for these analytes were established as the 95th percentile of the detection limits in the background data for these analytes. The results of this analysis are presented in **Table B2-4**. The background calculations for 1,2,3,4,7,8-HxCDF and the goodness of fit plot are presented in **Attachment B2-1**.

B3.0 HUMAN HEALTH RISK-BASED PRGS

This section presents the calculation of human health risk-based preliminary remediation goals (PRGs) in sediment and biota. Risk-based PRGs were calculated for all contaminants that posed an excess lifetime cancer risk greater than 1 x 10^{-6} or a hazard quotient greater than 1 in the final Portland Harbor Baseline Human Health Risk Assessment (BHHRA, Kennedy/Jenks 2013) assuming reasonable maximum exposure. For cancer effects, risk-based PRGs were calculated as the concentration consistent with a specified target excess cancer risk (TR) of 1×10^{-6}. For non-cancer effects, the risk-based PRGs were the calculated concentration that would result in a specified target hazard quotient (THQ) of 1. For both cancer and noncancer effects, the PRGs are calculated based on specified exposure pathways and receptors. Exposure values are summarized in **Table B3-1**, and unless otherwise noted, the source for each value is provided in Tables 3-21 through 3-25 in the BHHRA. A summary of the human health risk-based PRGs is presented in **Tables B3-4** and **B3-5**.

B3.1 PRGS FOR DIRECT CONTACT WITH SEDIMENT

Risk-based PRGs based on direct-contact pathways with sediment are calculated to account for incidental ingestion and dermal exposures. These values are then combined to derive a single risk-based PRG protective of both exposure pathways. These PRGs are presented in **Table B3-4** and the lowest value for each contaminant was selected as the risk-based PRG for RAO 1.

B3.1.1 Incidental Ingestion of Sediment

Risk-based PRGs associated with the incidental ingestion of sediment were calculated for child or adult receptors as appropriate using the following equations adapted from Section 3.5.1 of the BHHRA:

Noncancer effects:

$$PRG_{\mathrm{sed}} = \frac{THQ \times BW \times AT_{nc}}{EF \times ED \times \dfrac{1}{RfD} \times IRS \times 10^{-6}\, kg/mg} \qquad \text{Equation B3-1}$$

Carcinogenic effects:

$$PRG_{\mathrm{sed}} = \frac{TR \times BW \times AT_{c}}{EF \times ED \times CSF \times IRS \times 10^{-6}\, kg/mg} \qquad \text{Equation B3-2}$$

When exposure was assumed to occur from childhood through adult years, risk-based PRGs based on carcinogenic effects were age-weighted using the following Equation B3-4:

$$PRG_{sed} = \frac{TR \times AT_c}{CSF \times EF \times IFS_{adj} \times 10^{-6}\, kg/mg} \qquad \text{Equation B3-4}$$

where:

$$IFS_{adj} = \frac{ED_c \times IRS_c}{BW_c} + \frac{ED_a \times IRS_a}{BW_a} \qquad \text{Equation B3-5}$$

and:

- PRG_{sed} = risk-based PRG in soil or sediment (µg/kg or mg/kg)
- IFS_{adj} = age-adjusted soil/sediment incidental ingestion factor [(mg-year)/(kg-day)]
- IRS_a = incidental sediment ingestion rate-adults (mg/day)
- IRS_c = incidental sediment ingestion rate-children (mg/day)
- EF = exposure frequency (days/year)
- ED_a = exposure duration – adult (years)
- ED_c = exposure duration – child (years)
- BW_a = body weight – adult (kg)
- BW_c = body weight – child (kg)
- AT_{nc} = averaging time, noncancer (days)
- AT_c = averaging time, cancer (days)
- THQ = target hazard quotient
- TR = target cancer risk
- CSF = cancer slope factor $(mg/kg\text{-}day)^{-1}$

Risk-based PRGs in sediment for contaminants known to be mutagenic (cPAHs) incorporate the age-dependent adjustment factors (ADAFs) of 10 and 3, respectively, for exposures occurring before 2 years of age and from ages 2 through 16 (see section 3.5.7 of the BHHRA) were calculated using Equation B3-6:

$$PRG_{sed} = \frac{TR \times AT_c}{EF \times CSF \times ISIFM_{adj} \times 10^{-6}\, kg/mg} \qquad \text{Equation B3-6}$$

where:

$$ISIFM_{adj} = \left(\begin{array}{l} \frac{(ED_{0\text{-}2} \times IRS_c) \times 10}{BW_c} + \frac{(ED_{2\text{-}6} \times IRS_c) \times 3}{BW_c} + \\ \frac{(ED_{6\text{-}16} \times IRS_a) \times 3}{BW_a} + \frac{(ED_{16\text{-}30} \times IRS_a) \times 1}{BW_a} \end{array} \right) \qquad \text{Equation B3-7}$$

and:

PRG_{sed} = chemical concentration in soil or sediment (mg/kg)
IRS_a = adult soil/sediment ingestion rate (mg/day)
IRS_c = child soil/sediment ingestion rate (mg/day)
$ISIFM_{adj}$ = incidental sediment ingestion factor for mutagens (mg-yr/kg-day)
EF = exposure frequency (days/year)
ED_{0-2} = exposure duration ages 0-2 (years)
ED_{2-6} = exposure duration ages 2-6 (years)
ED_{6-16} = exposure duration ages 6-16 (years)
ED_{16-30} = exposure duration ages 16-30 (years)
BW_a = adult body weight (kg)
BW_c = child body weight (kg)
AT_c = averaging time, carcinogens (days)
CSF = cancer slope factor $(mg/kg\text{-}day)^{-1}$
TR = target cancer risk

The exposure assumptions are provided in **Table B3-1**.

B3.1.2 Dermal Contact with Sediment

Risk-based PRGs for dermal contact with sediment were calculated for child or adult receptors as appropriate using the Equations B3-8 and B3-9 adapted from Section 3.5.2 of the BHHRA:

Non-cancer effects:

$$PRG_{sed} = \frac{THQ \times AT_{nc} \times BW}{EF \times ED \times \dfrac{1}{RfD} \times SA \times AF \times ABS \times 10^{-6} kg/mg} \quad \text{Equation B3-8}$$

Cancer effects:

$$PRG_{sed} = \frac{TR \times AT_c \times BW}{EF \times ED \times CSF \times SA \times AF \times ABS \times 10^{-6} kg/mg} \quad \text{Equation B3-9}$$

Combined child and adult age-weighted exposures resulting from dermal contact with contaminants in sediment for the recreational beach user exposure scenarios were calculated consistent with Equation B3-10:

$$PRG_{sed} = \frac{TR \times AT_c}{CSF \times EF \times DFS_{adj} \times 10^{-6} kg/mg} \quad \text{Equation B3-10}$$

where:

$$DFS_{adj} = \frac{ED_c \times EF_c \times AF_c \times SA_c}{BW_c} + \frac{ED_a \times EF_a \times AF_a \times SA_a}{BW_a} \quad \text{Equation B3-11}$$

and:

PRG_{sed} = concentration in soil or sediment (µg/kg or mg/kg)
DFS_{adj} = age-adjusted dermal contact factor [(mg-year)/(kg-day)]
ABS_{dermal} = dermal absorption efficiency
SA_a = exposed skin surface area – adult (square centimeters [cm^2])
SA_c = exposed skin surface area – child (cm^2)
AF_a = soil-to-skin adherence factor – adult (mg/cm^2)
AF_c = soil-to-skin adherence factor – child (mg/cm^2)
EF = exposure frequency (days/year)
ED_a = exposure duration – adult (years)
ED_c = exposure duration – child (years)
BW_a = body weight – adult (kg)
BW_c = body weight –child (kg)
AT = averaging time (days)
CSF = cancer slope factor $(mg/kg\text{-}day)^{-1}$
RfD = reference dose (mg/kg-day)
THQ = target hazard quotient
TR = target excess cancer risk

Risk-based PRGs for cPAHs based on dermal exposure to sediments were also calculated using the early-life exposure adjustments described in Section B4.1.3 and Equation B3-12:

$$PRG_{sed} = \frac{TR \times AT}{EF \times CSF \times DSCFM_{adj} \times ABS \times CF} \quad \text{Equation B3-12}$$

where:

$$DSCFM_{adj} = \left(\begin{array}{c} \frac{ED_{0\text{-}2} \times AF_c \times SA_c \times 10}{BW_c} + \frac{ED_{2\text{-}6} \times AF_c \times SA_c \times 3}{BW_c} + \\ \frac{ED_{6\text{-}16} \times AF_a \times SA_a \times 3}{BW_a} + \frac{(ED_{16\text{-}30} \times AF_a \times SA_a \times 1}{BW_a} \end{array} \right) \quad \text{Equation B3-13}$$

and:

PRG_{sed} = chemical concentration in soil or sediment (mg/kg)
ABS_{dermal} = dermal absorption efficiency
$DSCFM_{adj}$ = dermal sediment contact factor for mutagens (mg-yr/kg-day)
SA_a = adult exposed skin surface area (square centimeters [cm^2])
SA_c = child exposed skin surface area (cm^2)
AF_a = adult soil-to-skin adherence factor (mg/cm^2)
AF_c = child soil-to-skin adherence factor (mg/cm^2)
EF= = exposure frequency (days/year)
$ED_{0\text{-}2}$ = exposure duration ages 0-2 (years)

ED_{2-6} = exposure duration ages 2-6 (years)
ED_{6-16} = exposure duration ages 6-16 (years)
ED_{16-30} = exposure duration ages 16-30 (years)
BWa = adult body weight (kg)
BWc = child body weight (kg)
AT = averaging time (days)
TR = target excess cancer risk

Exposure assumptions are presented in **Table B3-1**.

The individual pathway-specific calculations are combined to a total risk-based PRG in sediment using Equation B3-14:

$$PRG_{sed} = \frac{1}{\frac{1}{PRG_{sed-Ingestion}} + \frac{1}{PRG_{sed-Dermal}}} \quad \text{Equation B3-14}$$

B3.2 FISH/SHELLFISH TISSUE PRGS

Risk-based preliminary remediation goals (PRGs) are calculated for fish/shellfish tissue and for sediment. Tissue concentrations were calculated as they represent a direct exposure point for human receptors, and because target tissue concentrations are needed to derive sediment PRGs for protection of human health due to fish consumption. These PRGs are presented in **Table B3-5** and the lowest value for each contaminant for sediment and biota was selected as the risk-based PRGs for RAO 2.

B3.2.1 Risk-Based Tissue PRGs for Direct Consumption

Risk-based tissue PRGs associated with consumption of fish and shellfish were calculated for resident fish using the following equations, adapted from Section 3.5.5 of the BHHRA:

Non-cancer effects:

$$PRG_{tissue} = \frac{THQ \times BW_c \times AT_{nc}}{ED_c \times EF \times \frac{1}{RfD} \times CR_c \times 0.001\, kg/g} \quad \text{Equation B3-15}$$

Carcinogenic effects:

$$PRG_{tissue} = \frac{TR \times BW_a \times AT_c}{ED_a \times EF \times CSF \times CR_a \times 0.001\, kg/g} \quad \text{Equation B3-16}$$

Combined child and adult exposure was evaluated consistent with the following equation:

$$PRG_{tissue} = \frac{TR \times AT_c}{EF \times CR_{adj} \times CSF \times 0.001\, kg/g} \quad \text{Equation 3-17}$$

where:

$$CR_{f-adj} = \frac{ED_c \times CR_c}{BW_c} + \frac{ED_a \times CR_a}{BW_a} \quad \text{Equation B3-18}$$

and:

PRG_{tissue}	=	risk-based concentration in fish or shellfish tissue (µg/kg, wet-weight)
CR_c	=	consumption rate of fish or shellfish – child (g/day, wet-weight)
CR_a	=	consumption rate of fish or shellfish – adult (g/day, wet-weight)
$CR_{f\text{-}adj}$	=	consumption rate of fish or shellfish – age-adjusted (g/day – wet weight)
EF	=	exposure frequency (days/year)
ED_c	=	exposure duration – child (years)
ED_a	=	exposure duration – adult (years)
BW_c	=	body weight – child (kg)
BW_a	=	body weight – adult (kg)
AT_{nc}	=	averaging time, noncancer (days)
AT_c	=	averaging time, cancer (days)
CSF	=	cancer slope factor $(mg/kg\text{-}day)^{-1}$, see **Table B3-2**
RfD	=	reference dose (mg/kg-day), see **Table B3-2**
THQ	=	target hazard quotient
TR	=	target cancer risk

The exposure assumptions are presented in **Table B3-1**.

B3.2.2 Risk-Based Tissue PRGs based on Infant Consumption of Breast Milk

Risk-based PRGs in fish and shellfish tissue were calculated using Equation B3-19, adapted from Section 3.5.6 of the BHHRA. The equation presumes steady-state conditions where maternal intake via fish consumption occurs over a period greater than the biological half-life of the contaminant in the body. Maternal intake was modified slightly from the method presented in Section B3.1.1 by assuming a maternal body weight of 66 kg, representing an age-weighted value for women aged 15-44 years (ODEQ 2010), consistent with the value used in the BHHRA.

$$PRG_{tissue}\ (\mu g/kg) = \frac{\left(\frac{\mathrm{THQ} \times \mathrm{BW_{inf}} \times \mathrm{AT_{inf}} \times \mathrm{RfD}}{\mathrm{f_{mbm}} \times \mathrm{CR_{milk}} \times \mathrm{ED_{inf}}}\right) \times \left[\ln(2) \times f_{fm}\right] \times BW_m \times AT_{nc}}{(h \times f_f) \times EF_a \times ED_a \times 10^{-3}\, kg/g \times 10^{-3}\, mg/\mu g \times AE \times CR_{fish}} \quad \text{Equation B3-19}$$

where:

PRG_{tissue}	=	risk-based PRG in fish/shellfish (µg/kg – wet weight)
THQ	=	target hazard quotient
RfD	=	reference dose (mg/kg-day)
AE	=	absorption efficiency of the chemical
h	=	biological half-life of chemical in the body (days)
f_f	=	fraction of absorbed chemical stored in fat
f_{fm}	=	fraction of mother's weight that is fat
f_{mbm}	=	fraction of fat in breast milk
CR_{milk}	=	infant consumption rate of breast milk (kg/day)
CR	=	maternal consumption rate of fish (g/day)
ED_{inf}	=	exposure duration of breastfeeding infant (days)
EF_a	=	exposure frequency – adult (maternal exposure, days/yr)
ED_a	=	exposure duration – adult (days)
BW_{inf}	=	average infant body weight (kg)
BW_m	=	average body weight – maternal (kg)
AT_{inf}	=	averaging time, infant exposure (days)
AT_{nc}	=	averaging time, noncancer (days)

B3.3 CALCULATION OF RISK-BASED PRGS IN SEDIMENT BASED ON CONSUMPTION OF FISH/SHELLFISH

Target tissue concentrations were calculated using the method described in Section B3.1.1. To calculate sediment PRGs for scenarios where fish consumption is primarily the fillet, it was necessary to determine the relationship between whole body and fillet-only concentrations, because both the BSAFs/BSARs and the FWM are based on whole body concentrations. The whole-body/fillet concentration ratios were calculated using the measured mean whole body and fillet concentrations of each COC on a river mile or fishing zone basis, and are presented in **Table B3-3**.

B3.3.1 Carcinogenic PAHs (cPAHs)

Section B1 presents a calculated BSAR for benzo(a)pyrene in field clams as the following equation:

$$\ln(PRG_{sed}) = \frac{\ln(C_{tissue}) - \ln(CF) + 2.47}{0.60} \qquad \text{Equation B3-20}$$

In order to calculate a PRG, the BSAR for benzo(a)pyrene was considered representative of total carcinogenic PAHs. Bioaccumulation is typically measured using lipid-normalized tissue concentrations in conjunction with organic carbon normalized contaminant concentrations in sediment, and expressed by the following general relationship:

$$\frac{(C_{tissue}/f_{lipid})}{(C_{sed}/f_{oc})} \qquad \text{Equation B3-21}$$

Thus, it is necessary to correct for site organic carbon and the lipid content of clams to arrive at a dry-weight sediment concentration:

$$\ln(PRG_{sed}) = \left[\frac{\left(\ln(C_{\text{tissue}}) - \ln(f_{lipid})\right) - \ln(CF) + 2.47}{0.60}\right] + \ln(f_{oc}) \qquad \text{Equation B3-22}$$

where:

$$PRG_{\text{sed}} = e^{\left[\frac{\left(\ln(C_{\text{tissue}}) - \ln(f_{lipid})\right) - \ln(CF) + 2.47}{0.60}\right] + \ln(f_{oc})} \qquad \text{Equation B3-23}$$

and:

PRG_{sed} = risk-based PRG in sediment, dry weight (µg/kg)
C_{tissue} = risk-based target fish/shellfish tissue concentration – wet weight (µg/kg)
CF = correction factor (2.31, see Table 4-1, Windward 2009)
f_{oc} = fraction organic carbon site sediments, dry weight (0.0171)
f_{lipid} = fraction of lipid in clam tissue, wet weight (0.22)

B3.3.2 PRGs calculated using the Food-Web Model

The Arnot and Gobas food-web model was refined for use at Portland Harbor as discussed in Section B1.3, and accounts for uptake of contaminants via direct incidental ingestion, dietary uptake, and uptake of dissolved contaminants via ingestion and gill uptake. The FWM was calibrated for chlorinated persistent organic contaminants (aldrin, dieldrin, chlordane, DDx, PCBs, and five specific dioxin/furan congeners). Although the BHHRA evaluated consumption of smallmouth bass, carp, brown bullhead, and crappie, the latter two species are not evaluated in the FWM. The Largescale sucker was used as a surrogate for bullhead, and sculpin as a surrogate for crappie, as they were considered representative of the same trophic group. Oregon human health ambient water quality criteria (DEQ, 2011) for consumption of water and organism were initially used for the contaminant concentration in water. Because specific AWQC have not been established for individual dioxin/furan congeners, the value for 2,3,7,8-TCDD was used for the input water concentration for all dioxin/furan congeners.

The calibrated version of the FWM was modified as discussed in Section B1.3.2.1 from the original version (Arnot and Gobas 2004) to account for the use of filtered water data to represent the bioavailable solute fraction (ϕ). Because AWQC for organic COCs are expressed as a total concentration, when calculating PRGs the bioavailable solute fraction was calculated per Arnot and Gobas (2004) as shown in **Table B1-11** and using Equation B3-27:

$$\phi = 1/1 + \chi_{POC} \times D_{POC} \times \alpha_{POC} \times K_{ow} + \chi_{DOC} \times D_{DOC} \times \alpha_{DOC} \times K_{ow} \qquad \text{Equation B3-24}$$

Where χ_{POC} and χ_{DOC} are the concentration of particulate and dissolved organic carbon in water (kg/L), respectively; D_{POC} and D_{DOC} represent the disequilibrium factor for particulate and dissolved organic carbon partitioning; and are proportionality constants describing the similarity of phase partitioning of POC and DOC in relation to partitioning in octanol. Site-specific values of 4 x 10^{-7} and 1.4 x 10^{-6} kg/L were used for χ_{POC} and χ_{DOC}, respectively. Values of 0.35 for α_{POC} and 0.028 for α_{DOC} were used, as cited in Arnot and Gobas (2004). A value of 1 was assigned to both D_{POC} and D_{DOC}, assuming equilibrium conditions.

The calculated concentrations in whole body fish of each species were converted to fillet concentrations using the whole-body/fillet ratios presented in **Table B3-3**. The resulting fillet concentrations were further combined as a weighted mean, with each species representing 25 percent of the total diet. The goal-seek function in Excel was then used to iteratively calculate a surface-weighted average sediment concentration that ultimately calculates the target average tissue concentration of the four modeled species. As noted above, Oregon AWQC were initially used to represent post-remedial surface water concentrations. However, in some instances this resulted in the calculation of a sediment PRGs less than zero. The mathematical explanation for this is that dissolved water concentrations alone are predicted to result in estimated tissue concentrations greater than the risk-based target. When this occurred, the PRG was set at zero.

B4.0 ECOLOGICAL RISK-BASED PRGS

Ecological risk-based PRGs in this FS are based on a combination of Site-specific toxicity testing data, risk-based toxicity reference values (TRVs) and dietary exposures identified in the Portland Harbor Baseline Ecological Risk Assessment (BERA, Windward Environmental 2013). A summary of the ecological risk-based PRGs for sediment is presented in **Tables B4-1** and **B4-2**.

B4.1 SEDIMENT PRGS BASED ON DIRECT EXPOSURE

Sediment PRGs developed for protection of ecological receptors via direct contact are expressed as dry weight (dw) contaminant concentrations. Unacceptable risk was determined in the BERA for three benthic species: clams, crayfish, and worms. PRGs are only developed for contaminants posing unacceptable risk to each species.

The values were derived from the benthic tissue-residue LOAEL TRVs in Table 6-27 of the BERA (Windward 2013), divided by site-specific biota-sediment accumulation regressions (BSARs) to obtain the protective sediment concentrations. Site-specific BSARs were developed and presented in **Tables B1-5** through **B1-8**. Since a sediment to tissue relationship was not established for copper, TBT and zinc (see Section B1), PRGs for were not developed for these contaminants. Therefore, sediment PRGs were only developed for DDx and PCBs in clams and crayfish. These PRGs are presented in **Table B4-1**.

Unacceptable benthic community risk was also established in the BERA using two Site-specific predictive models of toxicity to benthic species: the Logistic Regression Model (LRM) and the Floating Percentile Model (FPM). Both the LRM and FPM were derived from a set of 293 sediment toxicity tests where two species, the amphipod *Hyalella azteca* and the midge *Chironomus dilutus* (formerly *C. tentans*) were exposed to Site sediments, and the results evaluated for survival and biomass (growth). The L2 and L3 SQV values from the BERA Tables 6-10 and 6 11 were used for the benthic values, representing the LRM and the FPM, respectively. All FPM values were originally reported as bulk dry weight sediment concentrations; thus, no unit conversions are needed for PRGs derived from the FPM. The original TRVs from the LRM model were reported as bulk sediment, OC-normalized, percent fines-normalized, or OC-fines normalized (all dry weight), depending on the contaminant. These values were converted to bulk sediment concentrations assuming the site-wide average sediment organic carbon of 1.71 percent and 53.38 percent fines from the BERA database using the following equations:

For OC-fines normalization:

$$PRG_{LRM} = TRV_{LRNM-OCfines} \times 0.0171 \times 0.5338 \qquad \text{Equation B4-1}$$

or

For percent fines normalization:

$$PRG_{LRM} = TRV_{LRNM-percent\ fines} \times 0.5338 \qquad \text{Equation B4-2}$$

For percent OC normalization:

$$PRG_{LRM} = TRV_{LRNM-OC} \times 0.0171 \qquad \text{Equation B4-3}$$

The FPM did not include TRVs for total PAHs, only for HPAHs and LPAHs. Therefore, a sediment PRG for total PAHs could not be derived. The resulting risk-based PRGs are presented in **Table B4-1**.

The above PRGs discussed are all based on site-specific toxicity data. The lowest of these values for a given contaminant was selected as the PRG for RAO 5. COCs for which a site-specific value could not be developed (Lindane and zinc), the PEC values from Table 6-18 of the BERA are from McDonald et al (2000) and are used as the PRG. All the PEC values for all COCs are presented in **Table B4-1**.

B4.2 SEDIMENT PRGS BASED ON INGESTION OF BIOTA (PREY)

The relationship between contaminant concentrations in tissue (TRVs) and sediment were evaluated using either the food web model (FWM) or through development of biota-sediment accumulation factors (BSAFs) or biota-sediment accumulation regressions (BSARs). The FWM was used to calculate PRGs for DDE, DDx, PCBs and dioxin/furan congeners. BSAR/Fs were not developed for BEHP, cadmium, copper, mercury, and TBT due to lack of a relationship between sediment and tissue concentrations. The resulting risk-based PRGs are presented in **Table B4-2**. The PRGs discussed are all site-specific and the lowest of these values for a given contaminant was selected as the risk-based PRG for RAO 6.

B4.2.1 Tissue Residue-based PRGs

Sediment PRGs protective of fish are sediment concentrations calculated such that contaminant concentrations in whole body fish will be less than those linked to ecologically significant adverse effects directly on fish (but not secondary effects on consumers of exposed fish). BSARs were developed and presented in **Tables B1-8** and **B1-9** for fish with small home ranges (sculpin and small mouth bass). Biota-sediment accumulation factors (BSAFs) were developed and presented in **Table B1-10** for large home-range fish with large home ranges (black crappie, brown bullhead, carp, lamprey, largescale sucker, northern pikeminnow, and peamouth). For those contaminants where site-specific biota-sediment accumulation factors (BSAFs) or BSARs could not identify relationships between sediment and tissue concentrations, a nationwide theoretical BSAF of 4.0 was used for hydrophobic organic chemicals (USACE 2003, Appendix G).

B4.2.2 Fish, Avian and Mammalian Dietary PRGs

Sediment PRGs protective of the BERA fish, avian and mammalian assessment endpoints from dietary ingestion were estimated using either BSAFs or the Arnot and Gobas food web model as modified for Portland Harbor. Because a multi-species diet was used to evaluate risk associated with the dietary pathway, a range of PRGs were developed. PRGs based on prey ingestion were calculated using the following general formula:

$$PRG_{\text{sed}} = \left[\frac{\left(\frac{TRV_{dietary}}{CR} \right)}{BSAF \times f_{lipid}} \right] \times f_{oc} \times CF \qquad \text{Equation B4-4}$$

where:

PRG_{sed}	=	Preliminary remediation goal in sediment for a contaminant (µg/kg or mg/kg dry weight sediment)
$TRV_{dietary}$	=	Toxicity reference value for contaminant in the diet if the target ecological receptor (mg/kg or mg/kg BW-day), where BW us the body weight of the target receptor
CR	=	Consumption rate of prey items (kg/day or kg/kg body weight-day)
f_{lipid}	=	Decimal fraction of the lipid content of prey (unitless)
BSAF	=	Biota-sediment accumulation factor from sediment to prey (unitless)
f_{oc}	=	Decimal fraction of the organic carbon content of sediment (unitless)
CF	=	Units conversion factor as needed

BASFs and BSARs (as appropriate and available) are presented in Section B1-2, fish dietary TRVs are presented in Table 7-19 and avian and mammalian dietary TRVs are presented in Tables 8-9 and 8-10, respectively, of the BERA (Windward 2013). PRGs were developed for chlorinated pesticides, total PCBs, and specific dioxin/furan congeners using the FWM. The target prey tissue concentration was calculated as a weighted mean based on the prey-consumption portions within each target species diet, and are presented in Tables 7-17 and 8-6 of the Final Portland Harbor BERA. Oregon human health ambient water quality criteria (DEQ 2011) for consumption of water and organism were used for the contaminant concentration in water because these values are more stringent ARARs that are expected to be met through implementation of the remedy. The goal-seek function in Excel was then used to calculate a sediment concentration that resulted in the weighted mean target tissue concentration for each species presented in Tables 7-17, 8-11 and 8-13 of the BERA, and assuming a LOAEL endpoint.

B4.2.3 Sediment PRGs for Piscivorous Bird Egg

Parental contaminant levels accumulated from the diet of birds are in turn deposited in their eggs via maternal transfer. Sediment PRGs for contaminants in bird egg tissue were calculated for PCBs and dioxins/furans. Sediment PRGs from the bird egg line of evidence in the BERA were calculated as follows by first determining the target concentration in prey tissue:

$$Conc_{prey} = \frac{TRV_{bird\ egg\ tissue}}{BMF} \qquad \text{Equation B4-5}$$

where:

$Conc_{prey}$	=	Concentration in prey tissue (µg/kg)
$TRV_{bird\ egg\ tissue}$	=	Toxicity reference value for a contaminant in the eggs of the target avian receptor (µg/kg)
BMF	=	Prey to egg biomagnification factor (unitless)
CF	=	Units conversion factor as needed

Prey-to-egg biomagnification factors are 11 for PCBs and 1.9 for dioxins/furans.

Bird egg tissue TRVs are presented in Table 8-45 of the BERA, and as discussed in Section 8.2, this endpoint was evaluated only for piscivorus birds (osprey and bald eagle). Because the home range for the bald eagle is assumed to be greater than the area of the Site, PRGs for this endpoint on based on osprey. Once the prey tissue concentration was determined, the goal-seek function was used in the Excel version of the FWM to calculate a sediment PRG that equated to a target tissue concentration in eggs, assuming the same dietary proportions for osprey as presented in BERA Table 8-6. However, an exception to the stated dietary proportions was necessary for dioxins/furans due to the limited number of dioxin/furans analyses of fish tissue. Although 90 percent of the osprey diet at the Site consists of largescale sucker and pikeminnow, no tissue analyses of these species were performed for dioxin/furan congeners. Thus, dioxin concentrations in osprey prey species were extrapolated from analytical results from carp, smallmouth bass and brown bullhead. Fish species from the Site in the osprey diet for which dioxin tissue results are available. These three species account for 6, 2 and 2 percent of the osprey diet, respectively. Scaling these proportions 100 percent of the diet yields a diet of 60 percent carp, 20 percent bass, and 20 percent bullhead.

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Tables

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Table B1-1
Co-Located Samples Used in BSAR Development
Portland Harbor Superfund Site
Portland, Oregon

Sampling Location	Round	Sediment Sample ID	Field-Collected Crayfish	Laboratory-Exposed Worm	Laboratory-Exposed Clam	Field-Collected Clam	Field-Collected Sculpin
02R001	1	LWG0102R001SDS015C00	LWG0102R001TSCRWBC00				LWG0102R001TSSPWBC00
02R001	1	LWG0102R001SDS015C00					LWG0102R001TSSPWBC10
02R015	1	LWG0102R015SDS015C00	LWG0102R015TSCRWBC00				LWG0102R015TSSPWBC00
03R001	1	LWG0103R001SDS015C00	LWG0103R001TSCRWBC00				LWG0103R001TSSPWBC00
03R002	1	LWG0103R002SDS015C00	LWG0103R002TSCRWBC00				LWG0103R002TSSPWBC10
03R003	1	LWG0103R003SDS015C10	LWG0103R003TSCRWBC00				
03R004	1	LWG0103R004SDS015C11	LWG0103R004TSCRWBC00				LWG0103R004TSSPWBC10
03R004	1	LWG0103R004SDS015C20					LWG0103R004TSSPWBC20
03R005	1	LWG0103R005SDS015C00	LWG0103R005TSCRWBC00				LWG0103R005TSSPWBC00
03R032	1	LWG0103R032SDS015C00	LWG0103R032TSCRWBC00				LWG0103R032TSSPWBC00
03R034	1	LWG0103R034SDS015C00					LWG0103R034TSSPWBC00
04R003	1	LWG0104R003SDS015C00	LWG0104R003TSCRWBC00				LWG0104R003TSSPWBC00
04R004	1	LWG0104R004SDS015C00	LWG0104R004TSCRWBC10				LWG0104R004TSSPWBC00
05R001	1	LWG0105R001SDS015C00	LWG0105R001TSCRWBC00				LWG0105R001TSSPWBC00
05R003	1	LWG0105R003SDS015C00	LWG0105R003TSCRWBC00				
05R020	1	LWG0105R020SDS015C00					LWG0105R020TSSPWBC00
06R001	1	LWG0106R001SDS015C00	LWG0106R001TSCRWBC00				LWG0106R001TSSPWBC00
06R002	1	LWG0106R002SDS015C10				LWG0106R002TSCAWBC00	LWG0106R002TSSPWBC10
06R002	1	LWG0106R002SDS015C20					LWG0106R002TSSPWBC20
06R004	1	LWG0106R004SDS015C00	LWG0106R004TSCRWBC10				LWG0106R004TSSPWBC00
07R003	1	LWG0107R003SDS015C00	LWG0107R003TSCRWBC00			LWG0107R003TSCAWBC00	LWG0107R003TSSPWBC00
07R004	1	LWG0107R004SDS015C00	LWG0107R004TSCRWBC00				
07R006	1	LWG0107R006SDS015C00	LWG0107R006TSCRWBC00			LWG0107R006TSCAWBC00	LWG0107R006TSSPWBC00
08R001	1	LWG0108R001SDS015C00	LWG0108R001TSCRWBC00				LWG0108R001TSSPWBC00
08R002	1	LWG0108R002SDS015C00	LWG0108R002TSCRWBC00				LWG0108R002TSSPWBC00
08R003	1	LWG0108R003SDS015C00	LWG0108R003TSCRWBC00				LWG0108R003TSSPWBC00
09R001	1	LWG0109R001SDS015C10	LWG0109R001TSCRWBC10				LWG0109R001TSSPWBC00
09R001	1	LWG0109R001SDS015C20	LWG0109R001TSCRWBC20				
09R002	1	LWG0109R002SDS015C00	LWG0109R002TSCRWBC00				LWG0109R002TSSPWBC00
BT001/FC001	2	LW2-GBT001		LW2-BTLW001	LW2-BTLC001	LW2-BTFC001	
BT002/FC002	2	LW2-GBT002		LW2-BTLW002	LW2-BTLC002	LW2-BTFC002	
BT003/FC003	2	LW2-GBT003		LW2-BTLW003	LW2-BTLC003	LW2-BTFC003	
BT004/FC004	2	LW2-GBT004		LW2-BTLW004	LW2-BTLC004	LW2-BTFC004	
BT005/FC005	2	LW2-GBT005		LW2-BTLW005	LW2-BTLC005	LW2-BTFC005	
BT006-1/ FC006-1	2	LW2-GBT006-1		LW2-BTLW006-1	LW2-BTLC006-1	LW2-BTFC006 Rep 1	
BT006-2	2	LW2-GBT006-2		LW2-BTLW006-2	LW2-BTLC006-2		
BT007/FC007	2	LW2-GBT007		LW2-BTLW007	LW2-BTLC007	LW2-BTFC007	
BT008/FC008	2	LW2-GBT008		LW2-BTLW008	LW2-BTLC008	LW2-BTFC008	

Table B1-1
Co-Located Samples Used in BSAR Development
Portland Harbor Superfund Site
Portland, Oregon

Sampling Location	Round	Sediment Sample ID	Field-Collected Crayfish	Laboratory-Exposed Worm	Laboratory-Exposed Clam	Field-Collected Clam	Field-Collected Sculpin
BT009/FC009	2	LW2-GBT009		LW2-BTLW009	LW2-BTLC009	LW2-BTFC009	
BT010/FC010	2	LW2-GBT010		LW2-BTLW010	LW2-BTLC010	LW2-BTFC010	
BT011	2	LW2-GBT011		LW2-BTLW011	LW2-BTLC011	LW2-BTFC011	
BT012/FC012	2	LW2-GBT012		LW2-BTLW012	LW2-BTLC012	LW2-BTFC012	
BT013/FC013	2	LW2-GBT013		LW2-BTLW013	LW2-BTLC013	LW2-BTFC013	
BT014/FC014	2	LW2-GBT014		LW2-BTLW014	LW2-BTLC014	LW2-BTFC014	
BT015/FC015	2	LW2-GBT015		LW2-BTLW015	LW2-BTLC015	LW2-BTFC015	
BT016/FC016	2	LW2-GBT016		LW2-BTLW016	LW2-BTLC016	LW2-BTFC016	
BT017/FC017	2	LW2-GBT017		LW2-BTLW017	LW2-BTLC017	LW2-BTFC017	
BT018	2	LW2-GBT018		LW2-BTLW018	LW2-BTLC018	LW2-BTFC018	
BT019/FC019	2	LW2-GBT019		LW2-BTLW019	LW2-BTLC019	LW2-BTFC019	
BT020/FC020	2	LW2-GBT020		LW2-BTLW020	LW2-BTLC020	LW2-BTFC020	
BT021/FC021	2	LW2-GBT021		LW2-BTLW021	LW2-BTLC021	LW2-BTFC021	
BT022/FC022	2	LW2-GBT022		LW2-BTLW022	LW2-BTLC022	LW2-BTFC022	
BT023/FC023	2	LW2-GBT023		LW2-BTLW023	LW2-BTLC023	LW2-BTFC023	
BT024/FC024	2	LW2-GBT024		LW2-BTLW024	LW2-BTLC024	LW2-BTFC024	
BT025/FC025	2	LW2-GBT025		LW2-BTLW025	LW2-BTLC025	LW2-BTFC025	
BT026/FC026	2	LW2-GBT026		LW2-BTLW026	LW2-BTLC026	LW2-BTFC026	
BT027-1/ FC027-1	2	LW2-GBT027-1		LW2-BTLW027-1	LW2-BTLC027-1	LW2-BTFC027 Rep 1	
BT027-2	2	LW2-GBT027-2		LW2-BTLW027-2	LW2-BTLC027-2		
BT028/FC028	2	LW2-GBT028		LW2-BTLW028	LW2-BTLC028	LW2-BTFC028	
BT029	2	LW2-GBT029		LW2-BTLW029	LW2-BTLC029	LW2-BTFC029	
BT030/FC030	2	LW2-GBT030		LW2-BTLW030	LW2-BTLC030	LW2-BTFC030	
BT031/FC031	2	LW2-GBT031		LW2-BTLW031	LW2-BTLC031	LW2-BTFC031	
BT032	2	LW2-GBT032		LW2-BTLW032	LW2-BTLC032	LW2-BTFC032	
BT033	2	LW2-GBT033		LW2-BTLW033	LW2-BTLC033	LW2-BTFC033	
CA02W	3	LW3-GCA02W-C10				LW3-CA02W-C00	
SP03E	3	LW3-GSP03E					LW3-SP03E-C00
CA03W	3	LW3-GCA03W-C00				LW3-CA03W-C00	
CA04W	3	LW3-GCA04W-C00				LW3-CA04W-C00	
SP04W	3	LW3-GSP04W					LW3-SP04W-C00
CA05E	3	LW3-GCA05E-C00				LW3-CA05E-C00	
SP05E	3	LW3-GSP05E					LW3-SP05E-C00
CR05W	3	LW3-GCR05W	LW3-CR05W-C00				
CA0	3	LW3-GCA05W-C00				LW3-CA05W-C00	
CR06W	3	LW3-GCRSP06W	LW3-CR06W-C00				
SP06W	3	LW3-GCRSP06W					LW3-SP06W-C00
SP07E	3	LW3-GSP07E					LW3-SP07E-C00

Table B1-1
Co-Located Samples Used in BSAR Development
Portland Harbor Superfund Site
Portland, Oregon

Sampling Location	Round	Sediment Sample ID	Field-Collected Crayfish	Laboratory-Exposed Worm	Laboratory-Exposed Clam	Field-Collected Clam	Field-Collected Sculpin
SP07W	3	LW3-GSP07W					LW3-SP07W-C00
SP08E	3	LW3-GSP08E					LW3-SP08E-C00
CR08W	3	LW3-GCRSP08W	LW3-CR08W-C00				
SP08W	3	LW3-GCRSP08W					LW3-SP08W-C00
SP09W	3	LW3-GSP09W					LW3-SP09W-C00
SP10E	3	LW3-GSP10E					LW3-SP10E-C00
CR10W	3	LW3-GCR10W	LW3-CR10W-C00				
CA10W	3	LW3-GCA10W-C00				LW3-CA10W-C00	
SP10W	3	LW3-GSP10W					LW3-SP10W-C00
CR11E	3	LW3-GCRSP11E	LW3-CR11E-C01				
CA11E	3	LW3-GCA11E-C00				LW3-CA11E-C00	
SP11E	3	LW3-GCRSP11E					LW3-SP11E-C00
Total number of co-located pairs			**28**	**35**	**35**	**43**	**37**

Table B1-2a
Sediment SWACs used in BSAR Development for Sculpin - Metals and Butyltins
Portland Harbor Superfund Site
Portland, Oregon

	Cadmium (mg/kg dw)			Copper (mg/kg dw)			Lead (mg/kg dw)			Tributyltin (mg/kg OC)		
Sample ID	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
LWG0102R015TSSPWBC00	0.19	1.92	0.55	20.9	52.6	40.1	12.0	105.7	24.8	0.19	0.22	0.21
LWG0102R001TSSPWBC00	0.15	1.57	0.38	18.8	46.2	36.7	8.1	105.7	18.2	NA	NA	NA
LWG0102R001TSSPWBC10	0.15	1.57	0.38	18.8	46.2	36.7	8.1	105.7	18.2	0.20	0.24	0.22
LWG0103R001TSSPWBC00	0.06	0.37	0.28	11.0	45.7	35.7	6.1	16.4	13.3	0.25	0.43	0.32
LWG0103R002TSSPWBC10	0.11	0.39	0.26	21.9	41.8	36.0	10.3	19.0	13.3	0.15	2.58	0.99
LWG0103R002TSSPWBC20	0.12	0.39	0.26	21.9	41.8	36.6	10.3	19.0	13.3	0.15	2.71	1.07
LW3-SP03E-C00	0.12	0.59	0.28	15.0	63.5	34.5	5.9	27.6	14.5	1.1	2267	223
LWG0103R005TSSPWBC00	0.20	2.59	0.61	16.6	133.4	52.3	11.5	202.3	58.7	0.84	6.74	2.90
LWG0103R032TSSPWBC00	0.11	0.40	0.24	20.0	39.9	33.0	5.2	25.5	13.6	0.89	4.49	3.09
LWG0103R034TSSPWBC00	0.06	0.38	0.17	16.0	58.4	25.5	2.7	33.8	11.3	0.22	4127	495
LWG0103R004TSSPWBC10	0.16	3.46	0.52	12.9	213.2	51.0	10.0	118.5	28.5	0.51	4.6	1.6
LWG0103R004TSSPWBC20	0.15	3.46	0.50	10.6	213.2	49.7	8.2	118.5	27.9	0.49	4.6	1.5
LWG0104R003TSSPWBC00	0.01	5.68	1.30	13.5	61.5	33.8	8.8	1906	266	0.61	1.9	1.3
LW3-SP04W-C00	0.12	0.38	0.22	15.2	69.2	35.3	9.2	60.7	15.0	0.06	1.6	0.54
LWG0104R002TSSPWBC00	0.20	10.05	3.93	16.0	63.0	44.2	5.4	1660	566	0.69	2.6	1.7
LWG0104R004TSSPWBC00	0.08	0.38	0.21	7.0	69.2	30.8	3.0	60.7	16.8	0.06	2.2	1.02
LWG0105R001TSSPWBC00	0.05	0.32	0.20	13.9	47.7	31.2	5.3	32.8	12.0	1.6	9.9	7.02
LW3-SP05E-C00	0.02	0.49	0.24	11.3	323.4	76.5	3.4	117.3	27.8	1.3	22.8	6.3
LWG0105R020TSSPWBC00	0.08	0.29	0.17	14.7	336.4	41.4	5.3	43.5	15.1	0.13	36.4	9.01
LWG0106R001TSSPWBC00	0.04	0.39	0.23	18.2	60.2	41.3	5.0	55.1	20.9	0.20	2.41	0.76
LW3-SP06W-C00	0.08	0.49	0.22	13.4	54.2	35.5	3.4	55.4	17.1	0.23	5.25	1.3
LWG0106R002TSSPWBC10	0.13	1.96	0.34	27.1	369.3	61.5	10.8	12961	701	0.03	15.9	3.0
LWG0106R002TSSPWBC20	0.13	1.96	0.34	28.7	369.3	61.8	10.8	12961	699	0.03	15.9	2.8
LWG0106R004TSSPWBC00	0.00	0.65	0.22	12.5	262.7	39.7	5.4	239.3	33.0	0.16	4.38	2.03
LWG0107R006TSSPWBC00	0.11	0.41	0.26	25.6	142.7	49.0	10.1	1195.9	49.3	0.21	6.76	2.0
LW3-SP07E-C00	0.18	0.99	0.31	37.8	278.7	60.8	9.0	220.6	26.1	1.1	84.5	14.3
LWG0107R003TSSPWBC00	0.05	0.47	0.21	16.2	258.6	40.5	9.1	139.4	16.8	0.21	5.40	2.33
LW3-SP07W-C00	0.00	0.69	0.30	15.6	58.9	37.5	6.0	66.4	19.7	0.01	1.1	0.32
LWG0108R002TSSPWBC00	0.12	0.54	0.32	16.8	96.5	37.8	11.2	49.0	15.2	1.06	12.75	6.3
LWG0108R003TSSPWBC00	0.10	0.69	0.33	66.0	1038	302.5	10.6	99.9	35.7	11.6	498	187
LW3-SP08E-C00	0.09	1.24	0.49	14.9	172.9	89.7	6.2	53.8	28.9	0.15	50.26	12.8
LWG0108R001TSSPWBC00	0.09	1.04	0.33	14.2	255.5	58.2	3.5	451.2	53.8	0.10	1.4	0.65
LW3-SP08W-C00	0.11	5.13	0.43	33.2	353.4	63.9	11.3	908.7	51.5	0.07	2.3	0.67
LWG0109R001TSSPWBC00	0.00	1.51	0.58	13.2	127.5	76.8	4.7	56.2	35.9	1.3	446	25.8
LW3-SP09W-C00	0.16	1.16	0.29	21.2	202.4	43.1	9.1	166.5	23.8	0.02	2.49	0.22
LWG0109R002TSSPWBC00	0.16	1.96	0.53	25.6	79.2	38.1	14.3	77.0	25.4	0.31	0.70	0.43
LW3-SP10E-C00	0.13	5.65	0.71	16.9	114.0	40.6	9.6	135.7	25.6	0.06	0.50	0.26
LW3-SP10W-C00	0.18	0.66	0.30	36.7	275.5	81.6	14.1	199.3	38.2	0.11	0.25	0.19
LW3-SP11E-C00	0.08	1.92	0.28	14.2	1591	110.5	4.2	131.4	43.9	0.19	0.70	0.41

Table B1-2b
Sediment SWACs used for Sculpin in the Mechanistic Model – PCBs
Portland Harbor Superfund Site
Portland, Oregon

	Total PCBs (µg/kg dw)				PCB 77 (µg/kg dw)				PCB 126 (µg/kg dw)		
Sample ID	**Min**	**Max**	**Mean**		**Min**	**Max**	**Mean**		**Min**	**Max**	**Mean**
LWG0102R015TSSPWBC00	20.1	1898	449		0.034	33.37	4.04		0.0033	1.02	0.136
LWG0102R001TSSPWBC00	18.2	1606	247		0.036	33.37	4.87		0.0024	1.02	0.154
LWG0102R001TSSPWBC10	18.2	1606	247		0.036	33.37	4.87		0.0024	1.02	0.154
LWG0103R001TSSPWBC00	2.6	33.9	22.8		0.007	0.08	0.04		0.0006	0.005	0.003
LWG0103R002TSSPWBC10	1.5	29.2	14.3		0.023	0.03	0.03		0.0028	0.004	0.004
LWG0103R002TSSPWBC20	1.5	29.2	14.5		0.023	0.03	0.03		0.0027	0.004	0.004
LW3-SP03E-C00	3.2	220.0	61.5		0.011	0.07	0.03		0.0015	0.022	0.007
LWG0103R005TSSPWBC00	38.3	3394	879		0.061	1.51	0.74		0.0128	1.09	0.261
LWG0103R032TSSPWBC00	1.3	37.5	19.0		0.025	0.05	0.04		0.0031	0.007	0.006
LWG0103R034TSSPWBC00	13.3	569	98.7		0.045	0.63	0.29		0.0074	0.240	0.107
LWG0103R004TSSPWBC10	8.1	1668	195		0.027	1.31	0.42		0.0016	0.045	0.013
LWG0103R004TSSPWBC20	2.2	1668	186		0.013	1.31	0.40		0.0011	0.045	0.013
LWG0104R003TSSPWBC00	5.7	137	66.7		0.086	0.25	0.16		0.0137	0.050	0.027
LW3-SP04W-C00	2.3	129	28.2		0.034	0.09	0.06		0.0046	0.016	0.009
LWG0104R002TSSPWBC00	6.1	65.8	39.9		0.055	0.10	0.08		0.0081	0.016	0.012
LWG0104R004TSSPWBC00	1.3	129	29.5		0.034	0.09	0.05		0.0046	0.026	0.012
LWG0105R001TSSPWBC00	4.3	32.5	16.5		0.032	0.07	0.04		0.0032	0.012	0.005
LW3-SP05E-C00	0.86	181	36.1		0.002	0.15	0.05		0.0005	0.034	0.009
LWG0105R020TSSPWBC00	2.3	221	21.7		0.020	0.05	0.03		0.0030	0.010	0.005
LWG0106R001TSSPWBC00	5.5	117	29.0		0.027	0.19	0.08		0.0030	0.016	0.008
LW3-SP06W-C00	5.2	166	41.5		0.038	0.27	0.13		0.0028	0.023	0.013
LWG0106R002TSSPWBC10	1.9	3119	124		0.003	0.24	0.05		0.0007	0.294	0.030
LWG0106R002TSSPWBC20	1.9	3119	125		0.003	0.24	0.05		0.0008	0.294	0.030
LWG0106R004TSSPWBC00	1.8	343	71.9		0.030	0.78	0.20		0.0030	0.030	0.013
LWG0107R006TSSPWBC00	8.4	1567	190		0.024	2.96	0.69		0.0022	0.276	0.053
LW3-SP07E-C00	8.3	263	39.9		0.012	0.06	0.03		0.0014	0.011	0.005
LWG0107R003TSSPWBC00	4.2	1216	93.2		0.015	0.82	0.10		0.0026	0.042	0.008
LW3-SP07W-C00	0.7	736	217		0.006	0.14	0.07		0.0019	0.010	0.006
LWG0108R002TSSPWBC00	1.8	106	41.4		0.043	0.10	0.06		0.0059	0.021	0.009
LWG0108R003TSSPWBC00	5.1	1553	268		0.044	0.66	0.24		0.0098	0.213	0.061
LW3-SP08E-C00	12.6	416	177		0.007	0.28	0.11		0.0012	0.092	0.038
LWG0108R001TSSPWBC00	8.8	299	60.2		0.047	0.20	0.09		0.0046	0.035	0.011
LW3-SP08W-C00	15.1	29240	631		0.196	95.25	8.31		0.0107	1.93	0.186
LWG0109R001TSSPWBC00	5.3	296	125		0.051	0.30	0.18		0.0132	0.081	0.046
LW3-SP09W-C00	14.0	2345	203		0.016	4.25	0.81		0.0022	0.405	0.113
LWG0109R002TSSPWBC00	93.3	625	251		0.090	0.96	0.26		0.0142	0.060	0.027
LW3-SP10E-C00	13.2	164	40.6		0.014	0.04	0.02		0.0013	0.005	0.003
LW3-SP10W-C00	35.5	899	124		0.019	0.06	0.04		0.0050	0.026	0.013
LW3-SP11E-C00	176.9	5900	1297		0.005	0.07	0.02		0.0022	0.271	0.022

Table B1-2c

Sediment SWACs used for Sculpin in the Mechanistic Model - 4,4′-DDD, 4,4′-DDE, 4,4′-DDT, Aldrin, α-HCH

Portland Harbor Superfund Site

Portland, Oregon

	4,4′-DDD (µg/kg dw)			4,4′-DDE (µg/kg dw)			4,4′-DDT (µg/kg dw)			Aldrin (µg/kg dw)			α-HCH (µg/kg dw)		
Sample ID	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
LWG0102R015TSSPWBC00	0.36	3.9	1.6	0.07	7.2	2.5	0.34	10.9	2.1	0.017	4.7	0.89	0.033	0.95	0.29
LWG0102R001TSSPWBC00	0.36	3.4	1.6	0.34	7.2	2.6	0.23	10.9	1.9	0.019	4.7	1.0	0.034	2.11	0.26
LWG0102R001TSSPWBC10	0.36	3.4	1.6	0.34	7.2	2.6	0.23	10.9	1.9	0.019	4.7	1.0	0.034	2.11	0.26
LWG0103R001TSSPWBC00	0.07	2.9	1.6	0.04	3.0	2.2	0.05	9.6	3.4	0.010	1.0	0.23	0.009	0.16	0.093
LWG0103R002TSSPWBC10	1.9	9.8	3.6	0.66	6.7	2.6	0.68	203	10.9	0.035	1.1	0.47	0.060	2.11	0.27
LWG0103R002TSSPWBC20	1.9	9.8	3.6	0.91	6.7	2.7	0.63	203	10.5	0.035	1.1	0.45	0.060	2.29	0.30
LW3-SP03E-C00	0.28	2.0	1.4	0.20	2.5	1.6	0.19	40	6.8	0.028	1.6	0.45	0.019	1.11	0.11
LWG0103R005TSSPWBC00	0.48	22.6	5.0	0.27	17.6	3.1	0.19	29	4.4	0.017	1.2	0.41	0.012	0.97	0.22
LWG0103R032TSSPWBC00	0.39	29.2	6.4	0.30	5.4	2.6	0.51	29	5.0	0.024	0.59	0.23	0.030	1.38	0.21
LWG0103R034TSSPWBC00	0.19	8.6	1.6	0.14	3.9	1.0	0.18	7.3	1.1	0.035	0.80	0.25	0.007	0.44	0.088
LWG0103R004TSSPWBC10	0.93	8.7	3.2	0.82	6.5	2.3	1.0	11.2	3.4	0.033	3.1	0.36	0.030	0.78	0.13
LWG0103R004TSSPWBC20	0.56	8.7	3.2	0.44	6.5	2.3	1.0	11.2	3.4	0.029	3.1	0.35	0.030	0.78	0.12
LWG0104R003TSSPWBC00	0.21	8.6	2.1	0.20	4.7	2.1	0.23	8.4	2.9	0.10	4.8	0.74	0.013	3.43	0.52
LW3-SP04W-C00	1.4	33.5	4.8	0.64	8.8	3.1	0.18	45.4	3.6	0.025	1.2	0.25	0.012	4.22	0.24
LWG0104R002TSSPWBC00	0.28	12.9	3.3	0.30	3.4	1.7	0.23	13.9	3.8	0.087	0.45	0.24	0.041	0.48	0.24
LWG0104R004TSSPWBC00	0.58	41.8	6.1	0.15	8.8	2.6	0.08	45.4	1.8	0.022	1.2	0.24	0.012	5.59	0.50
LWG0105R001TSSPWBC00	0.22	2.5	1.6	0.26	3.0	1.5	0.18	4.8	1.1	0.030	0.79	0.41	0.024	1.41	0.20
LW3-SP05E-C00	0.25	90	4.5	0.23	6.6	1.8	0.14	61	4.0	0.022	1.5	0.43	0.023	1.57	0.21
LWG0105R020TSSPWBC00	0.66	74	19.9	0.39	5.3	2.5	0.40	33	10.0	0.040	9.2	2.1	0.018	0.78	0.14
LWG0106R001TSSPWBC00	1.5	100	13.4	1.8	8.7	3.5	0.90	197	22.5	0.029	3.5	0.74	0.021	1.09	0.35
LW3-SP06W-C00	2.8	597	74.6	0.81	37	9.8	2.4	141	21.9	0.086	0.84	0.43	0.028	0.73	0.22
LWG0106R002TSSPWBC10	0.21	41	3.1	0.10	4.5	1.7	0.14	291	11.9	0.023	0.47	0.12	0.012	0.48	0.14
LWG0106R002TSSPWBC20	0.21	43	3.5	0.10	4.6	1.7	0.14	298	13.7	0.023	0.48	0.13	0.012	0.48	0.14
LWG0106R004TSSPWBC00	0.63	316	41.6	0.47	827	35.9	0.33	433	32.3	0.018	24.5	2.2	0.022	22.1	1.09
LWG0107R006TSSPWBC00	1.8	2683	214.9	1.6	664	63.1	1.5	11592	1288	0.12	628	11.3	0.050	40.8	2.66
LW3-SP07E-C00	0.55	2.6	1.1	0.80	2.8	1.7	0.06	11.0	1.2	0.022	0.89	0.19	0.014	0.89	0.12
LWG0107R003TSSPWBC00	1.6	2683	67.6	0.30	1107	47.3	0.12	11592	297	0.028	46.5	2.4	0.033	46.2	2.03
LW3-SP07W-C00	0.26	272	61.0	0.15	55.5	14.4	0.13	36	2.6	0.018	0.95	0.39	0.019	0.64	0.12
LWG0108R002TSSPWBC00	0.36	2.0	1.2	0.38	2.9	1.7	0.05	2.1	0.3	0.016	0.23	0.05	0.017	0.13	0.05
LWG0108R003TSSPWBC00	0.41	8.9	2.9	0.58	8.1	3.0	0.08	139	13.4	0.030	1.01	0.18	0.012	1.00	0.13
LW3-SP08E-C00	0.27	3.6	2.0	0.18	4.9	2.1	0.20	2.2	1.0	0.024	0.81	0.13	0.024	0.81	0.12
LWG0108R001TSSPWBC00	1.0	58	8.1	1.4	72	7.0	0.31	62	7.6	0.024	17.5	0.98	0.013	1.30	0.26
LW3-SP08W-C00	0.78	1026	22.3	1.6	2129	45.9	0.31	27	2.5	0.061	126	4.0	0.021	9.51	0.27
LWG0109R001TSSPWBC00	0.17	2.9	1.7	0.10	4.1	2.3	0.11	7.8	2.3	0.11	3.0	0.77	0.038	1.55	0.40
LW3-SP09W-C00	0.25	10.6	2.9	1.1	19.0	4.8	0.06	9.5	1.6	0.032	4.8	0.50	0.030	4.82	0.41
LWG0109R002TSSPWBC00	0.54	4.6	1.5	0.55	2.3	1.4	0.39	12.7	3.5	0.032	2.8	0.81	0.023	2.02	0.37
LW3-SP10E-C00	0.33	5.4	0.94	0.05	2.8	1.2	0.11	9.6	1.3	0.019	1.7	0.29	0.009	1.24	0.25
LW3-SP10W-C00	0.70	2.5	1.5	0.53	3.9	1.9	0.30	4.7	2.0	0.071	1.8	0.39	0.054	1.79	0.34
LW3-SP11E-C00	0.12	4.4	1.4	0.08	1.7	0.7	0.75	341	56.1	0.060	0.93	0.30	0.049	1.62	0.36

Table B1-2d
Sediment SWACs used for Sculpin in the Mechanistic Model – β-HCH, Dieldrin, γ-HCH, Heptachlor, Heptachlor Epoxide
Portland Harbor Superfund Site
Portland, Oregon

Sample ID	beta-HCH (µg/kg dw)			Dieldrin (µg/kg dw)			gamma-HCH (µg/kg dw)			Heptachlor (µg/kg dw)			Heptachlor Epoxide (µg/kg dw)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
LWG0102R015TSSPWBC00	0.15	6.80	2.27	0.026	9.42	0.96	0.038	0.22	0.093	0.008	1.38	0.099	0.012	7.59	0.76
LWG0102R001TSSPWBC00	0.22	10.3	2.43	0.019	9.42	0.68	0.038	0.49	0.13	0.015	0.26	0.072	0.02	7.59	0.61
LWG0102R001TSSPWBC10	0.22	10.3	2.43	0.019	9.42	0.68	0.038	0.49	0.13	0.015	0.26	0.072	0.02	7.59	0.61
LWG0103R001TSSPWBC00	0.009	4.88	1.03	0.018	0.22	0.15	0.021	1.38	0.30	0.013	0.14	0.075	0.014	0.43	0.12
LWG0103R002TSSPWBC10	0.069	5.50	2.22	0.045	1.31	0.27	0.044	3.97	0.51	0.018	0.31	0.051	0.023	0.83	0.09
LWG0103R002TSSPWBC20	0.069	5.50	2.41	0.045	1.31	0.26	0.044	3.97	0.58	0.018	0.33	0.054	0.023	0.90	0.09
LW3-SP03E-C00	0.025	3.62	0.69	0.026	0.82	0.20	0.047	2.25	0.29	0.015	0.18	0.059	0.021	0.27	0.07
LWG0103R005TSSPWBC00	0.059	7.70	2.14	0.026	0.64	0.11	0.012	2.60	0.70	0.0066	0.50	0.11	0.004	0.55	0.08
LWG0103R032TSSPWBC00	0.11	4.33	2.02	0.035	0.98	0.25	0.031	1.02	0.29	0.020	0.48	0.10	0.026	0.50	0.13
LWG0103R034TSSPWBC00	0.025	2.69	0.53	0.025	0.88	0.14	0.012	2.53	0.44	0.0048	0.44	0.07	0.006	0.45	0.08
LWG0103R004TSSPWBC10	0.049	1.35	0.52	0.018	1.33	0.30	0.017	0.97	0.15	0.015	0.33	0.078	0.01	0.23	0.11
LWG0103R004TSSPWBC20	0.015	1.35	0.51	0.018	1.33	0.29	0.011	0.97	0.15	0.012	0.33	0.076	0.006	0.23	0.11
LWG0104R003TSSPWBC00	0.066	4.69	0.77	0.17	3.63	0.64	0.027	4.22	0.64	0.013	3.81	0.57	0.015	4.04	0.61
LW3-SP04W-C00	0.025	1.62	0.49	0.040	0.63	0.29	0.015	0.88	0.27	0.0086	0.56	0.090	0.014	0.55	0.15
LWG0104R002TSSPWBC00	0.28	0.52	0.45	0.189	0.36	0.27	0.080	0.36	0.20	0.050	0.32	0.17	0.053	0.34	0.17
LWG0104R004TSSPWBC00	0.025	1.58	0.45	0.033	0.90	0.28	0.015	0.88	0.18	0.0086	0.56	0.097	0.014	0.55	0.13
LWG0105R001TSSPWBC00	0.075	2.13	0.72	0.049	0.93	0.43	0.12	2.02	0.57	0.042	0.51	0.18	0.028	0.54	0.19
LW3-SP05E-C00	0.08	6.38	1.11	0.035	3.49	0.34	0.034	4.20	0.47	0.021	1.36	0.18	0.027	1.36	0.19
LWG0105R020TSSPWBC00	0.12	12.9	3.61	0.032	6.27	1.63	0.041	5.50	1.15	0.016	0.47	0.104	0.021	0.47	0.14
LWG0106R001TSSPWBC00	0.093	7.02	0.65	0.12	1.39	0.53	0.027	2.36	0.57	0.026	0.68	0.21	0.008	4.19	0.51
LW3-SP06W-C00	0.042	8.95	1.72	0.049	10.9	1.42	0.091	1.89	0.74	0.022	0.69	0.16	0.025	1.48	0.21
LWG0106R002TSSPWBC10	0.023	5.16	0.80	0.032	1.93	0.26	0.018	4.55	0.41	0.0044	0.46	0.082	0.010	3.91	0.36
LWG0106R002TSSPWBC20	0.023	5.80	0.86	0.035	1.93	0.27	0.018	5.17	0.47	0.0044	0.47	0.088	0.010	4.44	0.41
LWG0106R004TSSPWBC00	0.064	22.0	2.76	0.031	43.54	1.79	0.031	22	1.79	0.017	22	0.87	0.022	22	1.34
LWG0107R006TSSPWBC00	0.065	38.4	3.31	0.073	128	7.35	0.092	406	13.6	0.029	38	2.50	0.047	38	3.76
LW3-SP07E-C00	0.030	4.60	0.67	0.020	0.99	0.14	0.020	1.04	0.22	0.0020	0.64	0.093	0.008	0.49	0.11
LWG0107R003TSSPWBC00	0.041	46.3	3.15	0.060	93.4	4.00	0.067	46.3	2.27	0.027	46	1.94	0.035	47	2.36
LW3-SP07W-C00	0.079	5.89	1.86	0.016	0.73	0.16	0.032	0.79	0.17	0.017	0.71	0.19	0.022	0.75	0.18
LWG0108R002TSSPWBC00	0.019	2.09	0.45	0.027	0.22	0.08	0.040	1.65	0.37	0.015	0.11	0.031	0.020	0.18	0.04
LWG0108R003TSSPWBC00	0.032	9.41	3.47	0.021	9.96	0.84	0.008	4.35	1.13	0.012	1.00	0.12	0.0084	1.50	0.18
LW3-SP08E-C00	0.028	1.95	0.66	0.018	4.73	1.20	0.031	0.82	0.18	0.021	0.80	0.12	0.025	0.81	0.13
LWG0108R001TSSPWBC00	0.013	6.44	1.11	0.04	13.7	1.24	0.016	6.82	0.98	0.003	1.80	0.20	0.011	0.77	0.21
LW3-SP08W-C00	0.082	6.54	1.22	0.031	338	6.10	0.039	0.69	0.17	0.021	0.62	0.11	0.025	1.08	0.30
LWG0109R001TSSPWBC00	0.12	2.53	1.19	0.14	3.06	1.03	0.11	4.73	1.80	0.040	2.99	0.67	0.045	2.10	0.47
LW3-SP09W-C00	0.091	5.42	1.85	0.043	9.45	0.60	0.039	4.82	0.46	0.027	4.82	0.33	0.036	4.82	0.45
LWG0109R002TSSPWBC00	0.12	5.68	2.17	0.034	4.83	0.82	0.034	6.69	1.49	0.011	0.66	0.19	0.026	0.88	0.21
LW3-SP10E-C00	0.017	5.08	0.82	0.017	1.24	0.1	0.014	5.98	0.66	0.0029	1.32	0.12	0.011	1.48	0.17
LW3-SP10W-C00	0.11	8.35	0.89	0.10	1.9	0.42	0.075	8.48	0.85	0.042	1.88	0.4	0.099	1.89	0.41
LW3-SP11E-C00	0.070	5.03	2.04	0.025	22.1	2.7	0.2	5.31	2.01	0.120	1.06	0.33	0.078	4.91	1.04

Table B1-2e
Sediment SWACs used for Sculpin in the Mechanistic Model - Sum DDD, Sum DDE, Sum DDT, Chlordane, DDx
Portland Harbor Superfund Site
Portland, Oregon

Sample ID	Sum DDD (µg/kg dw)			Sum DDE (µg/kg dw)			Sum DDT (µg/kg dw)			Chlordane (µg/kg dw)			DDx (µg/kg dw)		
	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
LWG0102R015TSSPWBC00	1.14	11.9	2.61	0.07	12.4	2.93	0.27	11.17	3.03	0.04	7.66	1.36	3.88	19.8	7.88
LWG0102R001TSSPWBC00	1.20	4.7	2.23	0.46	12.4	3.10	0.32	11.17	2.77	0.25	7.66	1.39	3.43	13.6	7.54
LWG0102R001TSSPWBC10	1.20	4.7	2.23	0.46	12.4	3.10	0.32	11.17	2.77	0.25	7.66	1.39	3.43	13.6	7.54
LWG0103R001TSSPWBC00	0.08	3.4	1.91	0.04	3.88	2.63	0.03	9.82	3.38	0.02	0.90	0.37	0.17	15.9	7.83
LWG0103R002TSSPWBC10	2.19	12.0	4.55	0.91	7.01	3.04	0.95	222	11.93	0.31	2.10	0.69	5.23	242	19.6
LWG0103R002TSSPWBC20	2.19	12.0	4.46	1.24	7.01	3.19	0.93	222	11.48	0.32	2.21	0.73	5.31	242	19.2
LW3-SP03E-C00	0.44	4.8	2.34	0.24	3.07	1.89	0.32	41	7.35	0.19	5.5	1.53	1.00	44.9	11.6
LWG0103R005TSSPWBC00	0.58	27.2	6.72	0.30	20	4.34	0.24	61	7.21	0.02	18.6	3.63	1.10	85.1	17.9
LWG0103R032TSSPWBC00	0.47	30.4	7.30	0.32	7.3	2.87	0.77	30	5.92	0.35	2.62	0.94	1.60	58.0	16.1
LWG0103R034TSSPWBC00	0.20	10.1	2.04	0.19	4.5	1.10	0.20	8.36	1.53	0.03	1.72	0.47	0.21	21.0	4.57
LWG0103R004TSSPWBC10	0.94	14.8	4.91	0.91	6.7	2.47	1.44	16	4.45	0.47	1.58	1.06	3.30	28.6	11.4
LWG0103R004TSSPWBC20	0.71	14.8	4.95	0.59	6.7	2.44	1.38	16	4.41	0.44	1.57	1.04	2.88	28.6	11.4
LWG0104R003TSSPWBC00	0.22	11.2	4.43	0.21	11.1	2.81	0.24	11	4.22	0.43	11.1	2.07	0.25	20.8	10.1
LW3-SP04W-C00	1.90	36.2	6.29	0.73	10.0	3.63	0.22	46	4.25	0.16	3.28	1.24	3.88	60.8	14.3
LWG0104R002TSSPWBC00	0.62	17.9	4.68	0.51	5.4	2.20	0.24	16	4.75	1.39	3.16	2.21	1.71	38.7	12.6
LWG0104R004TSSPWBC00	0.72	43.2	7.74	0.22	10	3.26	0.12	46	2.6	0.16	3.28	1.15	1.17	60.8	13.7
LWG0105R001TSSPWBC00	0.63	3.5	2.12	0.75	3.1	1.73	0.2	6.3	1.39	0.27	9.30	1.34	1.13	12.7	5.07
LW3-SP05E-C00	0.26	92.0	6.06	0.23	9.5	2.25	0.16	65	4.68	0.16	21.78	2.22	0.31	158	13.2
LWG0105R020TSSPWBC00	1.02	81.5	22	0.40	22.2	6.64	0.76	42	14.14	0.03	9.31	1.19	2.24	146	41.5
LWG0106R001TSSPWBC00	4.87	127	17	1.77	33.7	4.35	1.62	197	26.17	0.42	7.77	1.96	12.3	234	47.5
LW3-SP06W-C00	3.78	812	102	1.09	81.2	16	2.60	146	25.44	0.08	111	4.73	8.26	891	144
LWG0106R002TSSPWBC10	0.23	41.8	3.8	0.20	4.8	1.93	0.21	291	12.43	0.15	4.46	0.95	0.30	338	17.9
LWG0106R002TSSPWBC20	0.23	43.1	4.2	0.20	4.8	1.96	0.21	298	14.27	0.18	4.46	0.97	0.30	345	20.2
LWG0106R004TSSPWBC00	0.89	465	61	0.49	856	39	0.40	433	40	0.04	49	4.96	2.67	963	139
LWG0107R006TSSPWBC00	3.02	2934	279	1.74	1235	97	2.13	12556	1488	0.83	615	20.4	6.89	15453	1849
LW3-SP07E-C00	0.68	3.8	1.4	0.82	3.26	1.81	0.09	12	1.44	0.04	12.9	1.35	1.90	16.4	4.54
LWG0107R003TSSPWBC00	2.03	2934	86	0.31	1148	53	0.12	12556	364	0.12	63.1	5.75	4.28	15453	501
LW3-SP07W-C00	0.29	365	82	0.30	65	17	0.13	37.22	3.84	0.03	17.1	4.40	1.20	435.7	103
LWG0108R002TSSPWBC00	0.47	3.2	1.6	0.40	2.97	1.75	0.12	2.37	0.48	0.05	1.84	0.89	0.72	7.33	3.86
LWG0108R003TSSPWBC00	0.53	28.1	5.2	0.94	8.33	3.28	0.09	139	13.89	0.15	25.2	3.67	1.37	149	22.0
LW3-SP08E-C00	0.52	4.9	2.7	0.23	11.30	3.86	0.21	2.48	1.14	0.15	2.93	1.08	1.32	11.8	7.11
LWG0108R001TSSPWBC00	1.28	71.3	9.8	1.52	77	7.74	0.38	66	8.22	0.40	39.3	3.13	3.95	174	25.8
LW3-SP08W-C00	0.90	1302	29	1.68	2404	51	0.32	27.67	3.25	0.61	628	16.6	3.13	3735	83.4
LWG0109R001TSSPWBC00	0.25	4.2	2.4	0.32	5.03	3.15	0.25	13.76	2.91	0.25	8.12	2.64	0.32	20.7	7.35
LW3-SP09W-C00	0.66	48	5.9	1.22	21	5.26	0.07	17.59	2.36	0.51	11.3	1.79	2.91	70.9	12.7
LWG0109R002TSSPWBC00	0.97	6.9	3.0	0.63	3.18	2.06	0.49	13.68	4.85	1.48	7.78	2.85	2.55	19.0	9.36
LW3-SP10E-C00	0.49	9.9	1.7	0.05	4.16	1.49	0.24	13.84	1.98	0.24	24.7	2.23	1.42	28.9	5.26
LW3-SP10W-C00	0.97	13	2.7	0.53	4.10	2.06	0.44	8.47	3.11	0.40	8.11	2.27	3.64	20.6	7.64
LW3-SP11E-C00	4.78	86	21	0.57	9.84	2.68	8.29	361	61	3.31	350	75.53	14.7	437	86.6

Table B1-2f
Sediment SWACs used for Sculpin in the Mechanistic Model - Dioxin and Furan Congeners
Portland Harbor Superfund Site
Portland, Oregon

	1,2,3,7,8-PentaCDD (pg/g dw)			2,3,7,8-TetraCDD (pg/g dw)			1,2,3,4,7,8-HexaCDF (pg/g dw)			2,3,4,7,8-PentaCDF (pg/g dw)			2,3,7,8-TetraCDF (pg/g dw)		
Sample ID	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
LWG0102R015TSSPWBC00	0.012	0.62	0.14	0.005	0.25	0.054	0.02	3.5	1.0	0.017	2.7	0.84	0.021	3.0	0.96
LWG0102R001TSSPWBC00	0.017	0.62	0.31	0.008	0.25	0.12	0.08	3.5	2.0	0.060	2.7	1.5	0.09	3.0	1.6
LWG0102R001TSSPWBC10	0.017	0.62	0.31	0.008	0.25	0.12	0.08	3.5	2.0	0.060	2.7	1.5	0.09	3.0	1.6
LWG0103R001TSSPWBC00	0.0070	0.054	0.026	0.004	0.009	0.006	0.069	0.25	0.15	0.011	0.20	0.09	0.11	0.73	0.35
LWG0103R002TSSPWBC10	0.0070	0.048	0.026	0.008	0.027	0.015	0.16	1.2	0.36	0.032	1.6	0.30	0.16	7.5	1.2
LWG0103R002TSSPWBC20	0.0070	0.054	0.027	0.008	0.031	0.015	0.15	1.2	0.35	0.032	1.6	0.30	0.16	7.5	1.2
LW3-SP03E-C00	0.037	0.98	0.19	0.004	0.15	0.031	0.32	2.3	0.63	0.11	0.50	0.20	0.054	0.32	0.15
LWG0103R005TSSPWBC00	0.045	3.0	1.1	0.016	0.71	0.26	0.32	13	5.0	0.13	5.5	2.2	0.19	8.7	3.5
LWG0103R032TSSPWBC00	0.090	0.18	0.14	0.052	0.11	0.076	0.54	1.3	0.87	0.19	0.40	0.31	0.42	0.80	0.64
LWG0103R034TSSPWBC00	0.022	0.23	0.12	0.007	0.037	0.02	0.47	0.73	0.59	0.20	0.30	0.23	0.12	0.31	0.22
LWG0103R004TSSPWBC10	0.068	0.50	0.22	0.013	0.27	0.087	0.24	3.1	1.4	0.043	1.0	0.42	0.029	1.0	0.51
LWG0103R004TSSPWBC20	0.068	0.50	0.21	0.008	0.27	0.086	0.18	3.1	1.3	0.025	1.0	0.40	0.010	1.0	0.49
LWG0104R003TSSPWBC00	0.14	0.88	0.51	0.011	0.090	0.033	9.7	36	21	2.4	8.2	4.9	0.21	0.91	0.41
LW3-SP04W-C00	0.0060	0.60	0.17	0.003	0.46	0.1	0.06	14	5.0	0.023	6.0	1.9	0.092	5.3	1.9
LWG0104R002TSSPWBC00	0.067	0.44	0.21	0.008	0.025	0.016	11	21	15	2.7	4.7	3.5	0.26	0.37	0.34
LWG0104R004TSSPWBC00	0.0060	0.60	0.12	0.003	0.46	0.12	0.06	14	5.2	0.022	6.0	2.0	0.078	5.3	2.0
LWG0105R001TSSPWBC00	0.23	0.37	0.30	0.033	0.049	0.04	2.7	6.2	4.5	0.9	1.6	1.3	0.76	1.3	0.97
LW3-SP05E-C00	0.064	0.47	0.29	0.009	0.062	0.035	0.72	29	3.6	0.21	7.2	0.98	0.28	6.7	0.99
LWG0105R020TSSPWBC00	0.086	0.15	0.12	0.013	0.035	0.019	1.3	6.2	2.45	0.61	2.7	1.5	0.71	6.8	3.5
LWG0106R001TSSPWBC00	0.072	0.12	0.088	0.013	0.041	0.025	1.4	3.0	1.9	0.34	0.8	0.5	0.32	1.6	0.96
LW3-SP06W-C00	0.020	0.22	0.089	0.006	0.053	0.019	2.8	15	7.6	0.69	6.1	2.9	1.2	6.7	3.6
LWG0106R002TSSPWBC10	0.12	11	2.2	0.005	1.4	0.33	0.48	220	25	0.13	55	7.4	0.080	20	2.6
LWG0106R002TSSPWBC20	0.13	11	2.2	0.005	1.4	0.33	0.50	220	25	0.14	55	7.3	0.080	20	2.6
LWG0106R004TSSPWBC00	0.018	19	1.2	0.006	110	4.1	0.54	240	31	0.14	46	6.6	0.12	300	19
LWG0107R006TSSPWBC00	0.052	3.3	0.76	0.021	5.3	1.1	1.72	64,000	12,000	0.46	9,100	1,800	0.89	14,000	2,600
LW3-SP07E-C00	0.10	2.8	0.34	0.006	0.45	0.05	0.86	8.3	3.6	0.32	3.5	0.94	0.070	0.59	0.27
LWG0107R003TSSPWBC00	0.041	1.0	0.11	0.008	1.6	0.052	0.5	18,000	400	0.12	2,700	58	0.23	4,000	86
LW3-SP07W-C00	0.042	0.36	0.11	0.007	0.17	0.041	0.16	5.0	0.88	0.044	1.4	0.2	0.094	3.5	0.42
LWG0108R002TSSPWBC00	0.0090	0.070	0.014	0.007	0.017	0.009	0.078	0.32	0.11	0.024	0.10	0.05	0.047	0.18	0.072
LWG0108R003TSSPWBC00	0.011	0.32	0.16	0.006	0.067	0.039	0.092	1.4	0.83	0.007	0.40	0.22	0.097	0.55	0.28
LW3-SP08E-C00	0.072	0.16	0.10	0.014	0.036	0.024	1.0	2.0	1.3	0.20	0.40	0.24	0.017	0.22	0.092
LWG0108R001TSSPWBC00	0.045	0.35	0.15	0.004	0.63	0.14	0.15	1.2	0.49	0.053	0.50	0.19	0.049	0.43	0.17
LW3-SP08W-C00	0.078	1.5	0.56	0.039	4.1	1.27	0.12	5.6	2.0	0.068	1.6	0.66	0.063	1.5	0.63
LWG0109R001TSSPWBC00	0.10	1.1	0.42	0.016	0.17	0.063	1.2	16	5.3	0.27	4.1	1.37	0.12	1.6	0.63
LW3-SP09W-C00	0.25	0.54	0.39	0.050	0.51	0.11	2.3	5.6	4.0	1.56	4.1	2.7	1.4	3.9	2.6
LWG0109R002TSSPWBC00	0.13	2.8	1.1	0.024	0.59	0.22	0.48	8.5	3.0	0.15	1.9	0.85	0.06	1.4	0.56
LW3-SP10E-C00	0.12	0.30	0.21	0.017	0.074	0.049	0.26	1.2	0.48	0.047	0.7	0.25	0.096	0.16	0.13
LW3-SP10W-C00	0.13	0.83	0.38	0.008	0.11	0.035	0.71	5.2	2.2	0.28	3.7	1.18	0.11	0.62	0.42
LW3-SP11E-C00	0.16	0.45	0.29	0.033	0.10	0.054	0.48	1.3	0.85	0.16	0.6	0.35	0.053	0.24	0.14

Table B1-3a
Sediment SWACs used for Smallmouth Bass BSAR Development – Metals
Portland Harbor Superfund Site
Portland, Oregon

		Antimony (mg/kg dw)			Arsenic (mg/kg dw)			Lead (mg/kg dw)			Mercury (mg/kg dw)			Selenium (mg/kg dw)			Zinc (mg/kg dw)		
Sample ID	**Count**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
LWG0103R014TSSBWBC00	50	0.16	0.97	0.35	3.62	3.87	3.73	12.6	15.8	13.4	0.059	0.07	0.0667	0.115	0.544	0.28	99.7	117	104
LWG0104R023TSSBWBC10	50	0.41	1.63	1.0	3.62	3.87	3.78	13.5	38.2	22.3	0.059	0.07	0.0657	0.326	0.785	0.475	101	125	112
LWG0104R023TSSBWBC20	50	0.32	1.63	0.92	3.62	3.87	3.77	13	38.2	20.7	0.066	0.07	0.0663	0.28	0.785	0.461	99.9	125	111
LWG0104R023TSSBWBC30	50	0.32	1.63	0.94	3.62	3.87	3.78	13	38.2	21.2	0.065	0.07	0.0661	0.28	0.785	0.468	99.9	125	111
LWG0105R006TSSBWBC00	30	0.35	1.59	0.88	3.35	3.69	3.44	15.6	39.3	27.7	0.065	0.0715	0.0645	0.785	1.17	0.966	94.2	119	107
LWG0106R024TSSBWBC00	10	0.29	0.43	0.35	3.35	3.69	3.51	15.6	21.6	18.5	0.065	0.0825	0.0744	0.823	1.17	0.941	94.2	98.8	96.7
LWG0107R009TSSBWBC10	50	0.30	1.03	0.81	3.77	4.55	4.23	16.4	64.5	42.9	0.13	0.309	0.181	0.898	3.93	2.6	106	143	129
LWG0107R009TSSBWBC20	50	0.26	1.03	0.79	3.54	4.55	4.24	16.5	64.5	45.8	0.13	0.309	0.195	0.823	3.93	2.37	97.7	143	129
LWG0107R009TSSBWBC30	50	0.26	1.03	0.73	3.54	4.55	4.24	18.3	64.5	52	0.13	0.309	0.226	0.823	3.93	2.02	97.7	143	129
LWG0108R010TSSBWBC10	4	0.72	0.72	0.72	6.72	6.72	6.72	39.2	39.2	39.2	0.065	0.133	0.133	3.44	3.44	3.44	258	258	258
LWG0108R010TSSBWBC20	5	0.72	0.72	0.72	6.72	6.72	6.72	39.2	39.2	39.2	0.074	0.133	0.133	3.44	3.44	3.44	258	258	258
LWG0108R010TSSBWBC30	5	0.72	0.72	0.72	6.72	6.72	6.72	39.2	39.2	39.2	0.061	0.133	0.133	3.44	3.44	3.44	258	258	258
LWG0108R032TSSBWBC00	30	0.68	1.03	0.82	3.77	4.47	4.01	16.4	56.4	19.9	0.061	0.237	0.0754	1.82	3.93	3.29	114	139	122
LWG0109R006TSSBWBC00	20	0.70	0.82	0.74	3.84	4.15	4.04	17.4	21	19.6	0.034	0.0914	0.0817	1.29	2.97	1.79	114	122	119
LW3-SB010E-C00WB	50	0.24	0.67	0.35	3.34	4.02	3.78	15.5	25.1	18.3	0.043	0.0869	0.0728	0.117	1.21	0.271	93.6	111	107
LW3-SB010W-C00WB	50	0.24	0.66	0.33	3.48	4.02	3.75	15.5	25.1	17.7	0.061	0.0869	0.0701	0.121	0.871	0.303	98.5	111	108
LW3-SB011E-C00WB	47	0.24	0.83	0.62	2.18	3.99	2.74	24.2	30.9	26.7	0.061	0.0854	0.0548	0.055	0.123	0.0863	81.2	104	86.9
LW3-SB011W-C00WB	50	0.33	0.83	0.60	2.34	4.02	3.3	18.8	30.9	24.5	0.061	0.0869	0.0709	0.073	0.13	0.107	81.2	107	93.3
LW3-SB02E-C00WB	50	0.16	0.20	0.18	3.67	3.78	3.72	12.9	13.9	13.4	0.059	0.0714	0.067	0.115	0.191	0.149	102	120	112
LW3-SB03E-C00WB	50	0.16	0.48	0.22	3.64	3.79	3.73	12.6	14.1	13.2	0.059	0.07	0.0655	0.115	0.328	0.18	99.7	115	106
LW3-SB03W-C00WB	50	0.16	0.48	0.27	3.64	3.79	3.74	12.6	14.1	13.3	0.059	0.07	0.0657	0.115	0.328	0.219	99.7	112	103
LW3-SB04E-C01WB	50	0.35	1.63	0.82	3.62	3.87	3.77	13.1	38.2	18.6	0.059	0.07	0.0672	0.3	0.782	0.443	99.9	125	109
LW3-SB04W-C00WB	50	0.32	1.63	1.07	3.54	3.87	3.78	13	38.2	24.1	0.065	0.07	0.065	0.28	0.799	0.503	99.9	125	114
LW3-SB05W-C00WB	50	0.35	1.63	1.12	3.35	3.81	3.52	15.6	39.3	31.9	0.065	0.0715	0.0628	0.407	1.17	0.892	94.2	125	113
LW3-SB06E-C00WB	50	0.26	1.48	0.48	3.35	4.47	3.67	15.6	64.5	37	0.065	0.309	0.154	0.799	1.81	0.997	94.2	141	106
LW3-SB06W-C00WB	50	0.26	0.88	0.40	3.35	4.47	3.72	15.6	64.5	37.1	0.065	0.309	0.164	0.823	1.81	1.01	94.2	141	106
LW3-SB07E-C00WB	50	0.26	1.03	0.73	3.54	4.55	4.17	16.5	64.5	45.8	0.065	0.309	0.197	0.823	3.93	2.25	97.7	143	126
LW3-SB07W-C00WB	50	0.26	1.03	0.81	3.66	4.55	4.26	16.5	64.5	46.4	0.061	0.309	0.197	0.898	3.93	2.48	105	143	130
LW3-SB08E-C00WB	41	0.68	1.03	0.84	3.77	6.72	4.1	16.4	56.4	20.3	0.071	0.237	0.0751	2.2	3.93	3.4	114	258	126
LW3-SB08W-C00WB	50	0.68	1.03	0.79	3.77	4.52	4.04	16.4	58.5	21.4	0.059	0.248	0.0861	1.36	3.93	2.63	114	141	122
LW3-SB09E-C00WB	50	0.24	0.82	0.61	3.48	4.15	3.88	15.5	21	18.5	0.059	0.0914	0.0744	0.209	1.82	1.08	105	122	113
LW3-SB09W-C00WB	50	0.58	0.82	0.73	3.8	4.15	4.04	17.6	21	19.6	0.066	0.0914	0.0809	1.03	2.2	1.46	108	122	117

Table B1-3b
Sediment SWACs used for Smallmouth Bass in the Mechanistic Model – PCBs
Portland Harbor Superfund Site
Portland, Oregon

		Total PCBs (µg/kg dw)				PCB 77 (µg/kg dw)				PCB 126 µg/kg dw)		
Sample ID	**Count**	**Min**	**Max**	**Mean**		**Min**	**Max**	**Mean**		**Min**	**Max**	**Mean**
LWG0103R014TSSBWBC00	50	20.6	75.7	42.6		0.04	0.71	0.20		0.004	0.026	0.013
LWG0104R023TSSBWBC10	50	31.4	65	55.9		0.06	0.10	0.08		0.007	0.018	0.015
LWG0104R023TSSBWBC20	50	20.6	65	54.7		0.04	0.10	0.08		0.004	0.018	0.015
LWG0104R023TSSBWBC30	50	20.6	65	54.4		0.04	0.10	0.08		0.004	0.018	0.015
LWG0105R006TSSBWBC00	30	20.5	31.4	24.9		0.06	0.06	0.06		0.007	0.009	0.007
LWG0106R024TSSBWBC00	10	20.5	41.6	29.3		0.06	0.10	0.07		0.007	0.015	0.011
LWG0107R009TSSBWBC10	50	46.7	74.6	63.2		0.07	0.13	0.10		0.008	0.016	0.011
LWG0107R009TSSBWBC20	50	41.6	74.6	64.1		0.07	0.13	0.11		0.008	0.016	0.011
LWG0107R009TSSBWBC30	50	41.6	74.6	65.4		0.08	0.13	0.11		0.008	0.016	0.012
LWG0108R010TSSBWBC10	4	307	307	307		0.17	0.17	0.17		0.084	0.084	0.084
LWG0108R010TSSBWBC20	5	307	307	307		0.17	0.17	0.17		0.084	0.084	0.084
LWG0108R010TSSBWBC30	5	307	307	307		0.17	0.17	0.17		0.084	0.084	0.084
LWG0108R032TSSBWBC00	30	33.3	68.3	51		0.07	0.54	0.10		0.008	0.022	0.011
LWG0109R006TSSBWBC00	20	33.3	86.6	65.1		0.07	0.71	0.48		0.011	0.030	0.022
LW3-SB010E-C00WB	50	44.9	212	61.3		0.03	0.76	0.12		0.007	0.031	0.012
LW3-SB010W-C00WB	50	44.9	138	59.4		0.03	0.70	0.13		0.007	0.030	0.012
LW3-SB011E-C00WB	47	69.2	405	257		0.02	0.03	0.03		0.005	0.016	0.012
LW3-SB011W-C00WB	50	44.9	405	195		0.02	0.04	0.03		0.007	0.016	0.012
LW3-SB02E-C00WB	50	34.3	76.9	58.7		0.31	0.71	0.50		0.012	0.026	0.019
LW3-SB03E-C00WB	50	20.6	70.5	42.1		0.04	0.67	0.33		0.004	0.024	0.014
LW3-SB03W-C00WB	50	20.6	55.6	37.3		0.04	0.46	0.21		0.004	0.018	0.011
LW3-SB04E-C01WB	50	22	65	55.8		0.04	0.10	0.08		0.004	0.018	0.016
LW3-SB04W-C00WB	50	20.6	65	52.6		0.04	0.10	0.08		0.004	0.018	0.014
LW3-SB05W-C00WB	50	20.5	63.8	28.3		0.06	0.10	0.06		0.007	0.018	0.007
LW3-SB06E-C00WB	50	20.5	74.6	42.1		0.06	0.13	0.09		0.007	0.016	0.012
LW3-SB06W-C00WB	50	20.5	74.6	45.2		0.06	0.13	0.10		0.007	0.016	0.013
LW3-SB07E-C00WB	50	33	74.6	62.4		0.07	0.13	0.11		0.008	0.016	0.012
LW3-SB07W-C00WB	50	47.4	74.6	64.7		0.07	0.13	0.11		0.008	0.016	0.011
LW3-SB08E-C00WB	41	33.3	307	58.4		0.07	0.17	0.08		0.008	0.084	0.012
LW3-SB08W-C00WB	50	33.3	85.9	57.8		0.07	0.71	0.26		0.008	0.030	0.015
LW3-SB09E-C00WB	50	46.7	100	79.6		0.08	0.76	0.56		0.012	0.031	0.026
LW3-SB09W-C00WB	50	33.3	96.7	75.7		0.13	0.76	0.61		0.013	0.031	0.026

Table B1-3c
Sediment SWACs used for Smallmouth Bass in the Mechanistic Model – PAHs, Phthalates, and other SVOCs
Portland Harbor Superfund Site
Portland, Oregon

		Benzo(a)anthracene (mg/kg OC)			Benzo(a)pyrene (mg/kg OC)			Dibenzo(a,h)anthracene (mg/kg OC)			Bis(2-ethylhexyl) phthalate (mg/kg OC)			Hexachlorobenzene (mg/kg OC)		
Sample ID	**Count**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
LWG0103R014TSSBWBC00	50	2.73	17.2	14.4	4.6	27.4	23	0.55	3.03	2.5	3.3	19.1	7.6	0.09	0.17	0.14
LWG0104R023TSSBWBC10	50	13.1	78.7	29.1	20.7	106	42.4	2.31	13.8	5.4	9	19.9	16.8	0.11	0.28	0.19
LWG0104R023TSSBWBC20	50	13.1	78.7	26.3	20.7	106	38.7	2.31	13.8	4.8	3.6	19.9	16	0.11	0.28	0.18
LWG0104R023TSSBWBC30	50	13.1	78.7	27.2	20.7	106	39.9	2.31	13.8	5.01	3.6	19.9	16	0.11	0.28	0.18
LWG0105R006TSSBWBC00	30	78.7	443	295	106	563	378	13.8	49.1	36.3	9	73.9	54.3	0.24	0.31	0.27
LWG0106R024TSSBWBC00	10	308	443	376	381	563	474	34.5	49.1	41.7	8.0	73.9	48.3	0.28	0.71	0.45
LWG0107R009TSSBWBC10	50	2.04	130	27	2.1	161	32	0.38	17.2	3.9	5.7	11.6	10	0.18	0.52	0.26
LWG0107R009TSSBWBC20	50	2.04	308	41.7	2.1	381	50.4	0.39	34.5	5.6	5.7	11.5	9.72	0.18	0.70	0.29
LWG0107R009TSSBWBC30	50	3.3	308	53.6	3.4	381	64.9	0.72	34.5	7.2	5.7	11.1	9.42	0.18	0.70	0.32
LWG0108R010TSSBWBC10	4	11.9	11.9	11.9	11.6	11.6	11.6	1.71	1.7	1.7	93.9	93.9	93.9	0.21	0.21	0.21
LWG0108R010TSSBWBC20	5	11.9	11.9	11.9	11.6	11.6	11.6	1.71	1.7	1.7	93.9	93.9	93.9	0.21	0.21	0.21
LWG0108R010TSSBWBC30	5	11.9	11.9	11.9	11.6	11.6	11.6	1.71	1.7	1.7	93.9	93.9	93.9	0.21	0.21	0.21
LWG0108R032TSSBWBC00	30	2.0	7.17	2.9	2.07	7.6	3	0.37	1.5	0.61	9.8	13.6	11.1	0.13	0.24	0.20
LWG0109R006TSSBWBC00	20	2.0	3.4	2.6	2.07	2.9	2.4	0.37	0.47	0.41	11	13.9	12.5	0.12	0.18	0.14
LW3-SB010E-C00WB	50	2.9	4.5	3.6	2.6	4.8	4.0	0.43	0.85	0.65	10.9	22.1	18.4	0.08	0.15	0.094
LW3-SB010W-C00WB	50	2.9	4.4	3.6	3.2	4.8	3.8	0.48	0.85	0.62	12.5	22.1	18.3	0.08	0.15	0.092
LW3-SB011E-C00WB	47	1.5	4.5	3.5	1.8	4.8	3.6	0.28	0.85	0.61	12.9	282	87.1	0.013	0.15	0.10
LW3-SB011W-C00WB	50	3.4	4.5	4.07	3.5	4.8	4.3	0.60	0.85	0.72	12.9	124	35.9	0.022	0.15	0.12
LW3-SB02E-C00WB	50	2.2	15.1	7.4	3.8	24.3	11.9	0.47	2.6	1.3	3.2	3.4	3.3	0.094	0.16	0.13
LW3-SB03E-C00WB	50	3.7	17.2	12.3	6.2	27.4	19.6	0.702	3.03	2.2	3.3	12.6	3.7	0.094	0.16	0.14
LW3-SB03W-C00WB	50	9.3	17.2	15	14.7	27.4	24	1.6	3.03	2.7	3.3	12.6	5.0	0.11	0.16	0.15
LW3-SB04E-C01WB	50	13.1	64.7	21.8	20.7	88.7	32.8	2.3	12.1	4.0	3.7	19.9	15.9	0.11	0.28	0.16
LW3-SB04W-C00WB	50	13.1	163	34.9	20.7	214	49.9	2.3	24.2	6.3	3.6	19.9	15.9	0.11	0.28	0.20
LW3-SB05W-C00WB	50	55.5	443	226	78.2	563	293	10.4	49.1	29.5	9	73.9	43.3	0.24	0.31	0.26
LW3-SB06E-C00WB	50	21.8	443	248	23.4	563	313	3.2	49.1	29.3	5.7	73.9	27.7	0.21	0.71	0.46
LW3-SB06W-C00WB	50	21.8	443	244	23.4	563	306	3.2	49.1	28.3	5.7	73.9	24	0.21	0.71	0.48
LW3-SB07E-C00WB	50	2.04	333	53.8	2.1	413	65.5	0.39	37	7.06	5.7	11.5	9.5	0.18	0.71	0.31
LW3-SB07W-C00WB	50	2.04	154	30.8	2.1	200	36.8	0.39	20.6	4.4	5.7	11.5	9.9	0.18	0.53	0.27
LW3-SB08E-C00WB	41	2.0	11.9	3.3	2.07	11.6	3.4	0.37	1.7	0.67	9.8	93.9	13	0.15	0.24	0.21
LW3-SB08W-C00WB	50	2.0	8.8	3.03	2.07	9.71	3.02	0.37	1.8	0.57	9.8	13.9	11.8	0.12	0.24	0.17
LW3-SB09E-C00WB	50	2.08	3.7	3.2	2.2	3.4	2.9	0.37	0.51	0.46	10.9	19	13	0.090	0.13	0.11
LW3-SB09W-C00WB	50	2.0	3.4	2.9	2.09	3.02	2.6	0.37	0.48	0.42	10.9	13.9	12.3	0.11	0.15	0.12

Table B1-3d

Sediment SWACs used for Smallmouth Bass in the Mechanistic Model – 4,4´-DDD, 4, 4´-DDE, 4,4´-DDT, Aldrin, α-HCH

Portland Harbor Superfund Site

Portland, Oregon

		4,4′-DDD (µg/kg dw)			4,4′-DDE (µg/kg dw)			4,4′-DDT (µg/kg dw)			Aldrin (µg/kg dw)			α-HCH (µg/kg dw)		
Sample ID	**Count**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**	**Min**	**Max**	**Mean**
LWG0103R014TSSBWBC00	50	1.41	2.78	2.47	1.8	1.97	1.92	1.55	6.07	3.88	0.27	0.49	0.38	0.14	0.20	0.17
LWG0104R023TSSBWBC10	50	2.48	2.85	2.71	1.9	2.03	1.97	2.84	6.07	4.78	0.24	0.30	0.28	0.13	0.17	0.15
LWG0104R023TSSBWBC20	50	2.37	2.85	2.69	1.9	2.03	1.96	2.84	6.07	4.78	0.24	0.40	0.28	0.13	0.17	0.15
LWG0104R023TSSBWBC30	50	2.37	2.85	2.69	1.9	2.03	1.96	2.84	6.07	4.77	0.24	0.40	0.28	0.13	0.17	0.15
LWG0105R006TSSBWBC00	30	2.67	6.61	4.04	1.8	2.08	1.92	2.84	6.93	4.19	0.24	0.58	0.40	0.13	0.18	0.14
LWG0106R024TSSBWBC00	10	4.21	19.4	9.99	1.8	3.26	2.27	4.35	11.9	7.09	0.41	0.63	0.57	0.14	0.21	0.18
LWG0107R009TSSBWBC10	50	4.91	29.8	22.8	3.32	13.1	9.81	4.07	118	74.7	0.23	1.4	1.02	0.23	0.90	0.68
LWG0107R009TSSBWBC20	50	7.9	29.8	23.8	3.26	13.1	9.82	11.2	118	75.6	0.27	1.4	1.04	0.203	0.90	0.68
LWG0107R009TSSBWBC30	50	17	29.8	24.3	3.26	13.1	9.72	11.2	118	71.1	0.40	1.4	1.04	0.203	0.90	0.70
LWG0108R010TSSBWBC10	4	3.84	3.84	3.84	2.59	2.59	2.59	6.53	6.53	6.53	0.36	0.36	0.36	0.32	0.32	0.32
LWG0108R010TSSBWBC20	5	3.84	3.84	3.84	2.59	2.59	2.59	6.53	6.53	6.53	0.36	0.36	0.36	0.32	0.32	0.32
LWG0108R010TSSBWBC30	5	3.84	3.84	3.84	2.59	2.59	2.59	6.53	6.53	6.53	0.36	0.36	0.36	0.32	0.32	0.32
LWG0108R032TSSBWBC00	30	2.32	27.8	13.4	3	12.7	6.7	2.18	106	45.8	0.19	1.35	0.65	0.17	0.86	0.403
LWG0109R006TSSBWBC00	20	2.32	4.76	3.5	3	5.51	4.64	1.34	2.55	2.13	0.19	0.65	0.53	0.17	0.26	0.21
LW3-SB010E-C00WB	50	0.84	2.92	1.04	1.27	5.2	1.69	1.01	9.8	1.64	0.26	0.63	0.35	0.24	0.34	0.30
LW3-SB010W-C00WB	50	0.84	2.21	1.02	1.37	4.25	1.68	1.06	6.09	1.39	0.26	0.46	0.33	0.24	0.34	0.31
LW3-SB011E-C00WB	47	0.67	1.03	0.88	0.77	1.47	1.03	3.48	16.2	11.1	0.09	0.35	0.21	0.080	0.26	0.19
LW3-SB011W-C00WB	50	0.82	1.03	0.95	0.85	1.53	1.23	1.38	16.2	8.51	0.16	0.39	0.29	0.14	0.31	0.23
LW3-SB02E-C00WB	50	1.41	2.44	1.94	1.8	1.97	1.91	1.55	3.33	1.9	0.32	0.49	0.44	0.17	0.20	0.18
LW3-SB03E-C00WB	50	1.63	2.76	2.29	1.86	1.97	1.93	1.55	4.98	2.69	0.29	0.49	0.45	0.16	0.19	0.17
LW3-SB03W-C00WB	50	2.14	2.76	2.44	1.89	1.97	1.93	1.64	4.98	3.4	0.29	0.49	0.42	0.16	0.17	0.17
LW3-SB04E-C01WB	50	2.37	2.85	2.68	1.9	2.03	1.95	3.38	6.07	4.87	0.25	0.35	0.28	0.13	0.17	0.15
LW3-SB04W-C00WB	50	2.37	2.85	2.7	1.9	2.05	1.97	2.84	6.07	4.57	0.24	0.40	0.28	0.13	0.17	0.15
LW3-SB05W-C00WB	50	2.67	6.61	3.52	1.8	2.08	1.96	2.84	6.93	3.96	0.24	0.58	0.35	0.13	0.18	0.14
LW3-SB06E-C00WB	50	2.82	27.4	14.2	1.8	11.1	3.95	2.91	104	14.7	0.28	1.40	0.58	0.14	0.86	0.29
LW3-SB06W-C00WB	50	3.29	27.4	16.1	1.8	11.1	4.36	3.6	104	18.4	0.38	1.40	0.63	0.14	0.86	0.33
LW3-SB07E-C00WB	50	7.9	29.8	22.7	3	13.1	9.2	8.37	118	67.1	0.27	1.40	0.97	0.203	0.903	0.63
LW3-SB07W-C00WB	50	7.9	29.8	23.9	3.45	13.1	10.1	11.2	118	79.2	0.27	1.40	1.07	0.22	0.903	0.70
LW3-SB08E-C00WB	41	2.32	27.8	14.8	2.59	12.7	7.12	2.18	106	51.1	0.19	1.35	0.69	0.17	0.86	0.44
LW3-SB08W-C00WB	50	2.32	27.8	9.88	3	12.9	6.15	1.39	111	29.9	0.19	1.40	0.63	0.17	0.903	0.35
LW3-SB09E-C00WB	50	0.90	3.52	2.54	1.47	5.51	4.2	1.01	2.55	1.46	0.26	0.65	0.51	0.18	0.32	0.26
LW3-SB09W-C00WB	50	2.25	3.52	3.12	3.02	5.51	4.95	1.01	2.55	1.9	0.37	0.65	0.58	0.17	0.26	0.22

Table B1-3e

Sediment SWACs used for Smallmouth Bass in the Mechanistic Model – Sum DDD, Sum DDE, Sum DDT, Chlordane, DDx

Portland Harbor Superfund Site

Portland, Oregon

Sample ID	Count	Sum DDD (µg/kg dw)			Sum DDE (µg/kg dw)			Sum DDT (µg/kg dw)			Total Chlordane (µg/kg dw)			DDx (µg/kg dw)		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
LWG0103R014TSSBWBC00	50	2.02	3.57	3.14	1.94	2.27	2.22	2.28	6.64	4.48	0.77	0.94	0.84	6.56	12.5	9.91
LWG0104R023TSSBWBC10	50	3.19	3.92	3.62	2.2	2.32	2.26	3.33	6.64	5.37	0.78	1.07	0.95	9.47	12.5	11.3
LWG0104R023TSSBWBC20	50	3.04	3.92	3.57	2.2	2.32	2.26	3.33	6.64	5.38	0.78	1.07	0.93	9.47	12.5	11.3
LWG0104R023TSSBWBC30	50	3.04	3.92	3.57	2.2	2.32	2.26	3.33	6.64	5.36	0.78	1.07	0.94	9.47	12.5	11.3
LWG0105R006TSSBWBC00	30	3.81	8.28	5.37	2.16	2.61	2.36	3.33	8.35	4.94	1.04	1.34	1.15	9.47	19.1	12.6
LWG0106R024TSSBWBC00	10	5.52	25.6	12.9	2.25	5.45	3.45	5.04	13.6	8.44	1.13	2.35	1.53	12.7	44.2	24.6
LWG0107R009TSSBWBC10	50	7.24	40.9	31.4	3.71	16.8	12.5	5.02	136	86.5	1.86	4.16	3.18	16.3	192	130
LWG0107R009TSSBWBC20	50	10.9	40.9	32.9	5.19	16.8	12.6	12.7	136	87.4	1.91	4.16	3.27	38.5	192	132
LWG0107R009TSSBWBC30	50	23	40.9	33.6	5.19	16.8	12.6	12.7	136	82	2.35	4.16	3.33	40.6	192	128
LWG0108R010TSSBWBC10	4	5.87	5.87	5.87	3.28	3.28	3.28	7.59	7.59	7.59	2.42	2.42	2.42	16.7	16.7	16.7
LWG0108R010TSSBWBC20	5	5.87	5.87	5.87	3.28	3.28	3.28	7.59	7.59	7.59	2.42	2.42	2.42	16.7	16.7	16.7
LWG0108R010TSSBWBC30	5	5.87	5.87	5.87	3.28	3.28	3.28	7.59	7.59	7.59	2.42	2.42	2.42	16.7	16.7	16.7
LWG0108R032TSSBWBC00	30	3.6	38.2	18.4	3.28	16	8.25	2.47	122	53.4	1.75	3.57	2.42	9.45	175	79.8
LWG0109R006TSSBWBC00	20	3.6	7.03	5.31	3.28	6.06	5.1	1.7	2.91	2.46	1.75	2.97	2.46	9.45	14.3	12.9
LW3-SB010E-C00WB	50	1.42	4.4	1.86	1.59	5.7	1.95	1.42	10.9	2.11	1.12	11.6	1.81	4.6	17.2	5.86
LW3-SB010W-C00WB	50	1.42	3.61	1.82	1.59	4.74	1.94	1.46	6.82	1.82	1.12	4.98	1.53	4.6	11.8	5.49
LW3-SB011E-C00WB	47	1.95	7.12	4.95	1.2	1.77	1.64	4.18	19.3	13.4	1.93	21.9	12.6	7.89	28.7	20.4
LW3-SB011W-C00WB	50	1.45	7.12	3.93	1.61	1.77	1.72	1.79	19.3	9.97	1.75	21.9	9.66	4.8	28.7	15.9
LW3-SB02E-C00WB	50	2.02	3.05	2.54	1.94	2.26	2.13	2.28	3.91	2.64	0.75	0.94	0.85	6.56	9.25	7.28
LW3-SB03E-C00WB	50	2.24	3.51	2.91	2.03	2.27	2.21	2.28	5.52	3.33	0.78	0.94	0.86	6.71	11.4	8.47
LW3-SB03W-C00WB	50	2.75	3.51	3.09	2.2	2.27	2.24	2.43	5.52	4	0.78	0.90	0.84	7.34	11.4	9.37
LW3-SB04E-C01WB	50	3.04	3.92	3.52	2.2	2.32	2.26	3.89	6.64	5.46	0.78	1.07	0.911	10	12.5	11.3
LW3-SB04W-C00WB	50	3.04	4.01	3.63	2.2	2.35	2.27	3.33	6.64	5.16	0.78	1.1	0.97	9.47	12.5	11.1
LW3-SB05W-C00WB	50	3.81	8.28	4.78	2.16	2.61	2.33	3.33	8.35	4.62	1.04	1.34	1.13	9.47	19.1	11.7
LW3-SB06E-C00WB	50	4.01	38.3	19.1	2.16	14.7	5.52	3.4	119	16.8	1.1	4.16	2.06	9.78	171	41.3
LW3-SB06W-C00WB	50	4.58	38.3	21.7	2.16	14.7	6.16	4.2	119	21.1	1.13	4.16	2.24	11	171	48.7
LW3-SB07E-C00WB	50	10.9	40.9	31.3	5.13	16.8	11.9	9.99	136	77.5	1.84	4.16	3.13	37.5	192	120
LW3-SB07W-C00WB	50	10.9	40.9	33	5.19	16.8	13	12.7	136	91.6	1.91	4.16	3.29	38.5	192	137
LW3-SB08E-C00WB	41	3.6	38.2	20.3	3.28	16	8.83	2.47	122	59.5	1.75	3.57	2.5	9.45	175	88.3
LW3-SB08W-C00WB	50	3.6	38.2	13.8	3.28	16.4	7.32	1.74	129	34.8	1.75	3.75	2.52	9.45	182	55.8
LW3-SB09E-C00WB	50	1.58	5.55	4	1.7	6.06	4.64	1.42	2.91	1.83	1.12	2.97	2.12	4.65	14.3	10.4
LW3-SB09W-C00WB	50	3.6	5.55	4.8	3.28	6.06	5.44	1.42	2.91	2.24	1.9	2.97	2.51	9.45	14.3	12.5

Table B1-3e
Sediment SWACs used for Smallmouth Bass in the Mechanistic Model - β-BHC, Dieldrin, γ-HCH, Heptachlor, Heptachlor Epoxide
Portland Harbor Superfund Site
Portland, Oregon

Sample ID	Count	β-HCH (μg/kg dw)			Dieldrin (μg/kg dw)			γ-HCH (μg/kg dw)			Heptachlor (μg/kg dw)			Heptachlor Epoxide (μg/kg dw)		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
LWG0103R014TSSBWBC00	50	1.21	2.02	1.44	0.2	0.36	0.25	0.47	0.70	0.54	0.087	0.12	0.10	0.11	0.25	0.16
LWG0104R023TSSBWBC10	50	0.49	1.32	1.08	0.2	0.25	0.22	0.30	0.64	0.50	0.11	0.16	0.14	0.11	0.17	0.14
LWG0104R023TSSBWBC20	50	0.49	1.39	1.12	0.2	0.25	0.22	0.30	0.64	0.51	0.13	0.17	0.15	0.11	0.17	0.14
LWG0104R023TSSBWBC30	50	0.49	1.39	1.11	0.2	0.25	0.22	0.30	0.64	0.50	0.14	0.73	0.53	0.11	0.17	0.14
LWG0105R006TSSBWBC00	30	0.50	1.18	0.81	0.24	0.43	0.31	0.30	0.86	0.63	0.12	0.73	0.53	0.14	0.17	0.15
LWG0106R024TSSBWBC00	10	0.86	1.82	1.38	0.31	0.52	0.44	0.65	0.91	0.79	0.12	0.73	0.54	0.14	0.24	0.18
LWG0107R009TSSBWBC10	50	1.12	1.97	1.73	0.35	1.52	1.12	0.49	1.56	1.16	0.32	0.32	0.32	0.23	0.93	0.68
LWG0107R009TSSBWBC20	50	1.20	1.97	1.76	0.33	1.52	1.12	0.50	1.56	1.18	0.32	0.32	0.32	0.24	0.93	0.69
LWG0107R009TSSBWBC30	50	1.40	1.97	1.81	0.33	1.52	1.13	0.52	1.56	1.17	0.32	0.32	0.32	0.24	0.93	0.72
LWG0108R010TSSBWBC10	4	2.66	2.66	2.66	0.88	0.88	0.88	1.73	1.73	1.73	0.13	0.70	0.31	0.40	0.40	0.40
LWG0108R010TSSBWBC20	5	2.66	2.66	2.66	0.88	0.88	0.88	1.73	1.73	1.73	0.13	0.19	0.16	0.40	0.40	0.40
LWG0108R010TSSBWBC30	5	2.66	2.66	2.66	0.88	0.88	0.88	1.73	1.73	1.73	0.15	0.36	0.26	0.40	0.40	0.40
LWG0108R032TSSBWBC00	30	0.87	1.97	1.31	0.46	1.45	0.79	0.48	1.46	0.84	0.18	0.36	0.25	0.17	0.89	0.39
LWG0109R006TSSBWBC00	20	0.87	1.26	1.06	0.46	1.02	0.80	0.43	0.54	0.49	0.11	0.36	0.25	0.17	0.25	0.21
LW3-SB010E-C00WB	50	0.48	1.36	0.97	0.24	0.80	0.35	0.39	0.81	0.67	0.19	0.36	0.31	0.21	0.51	0.30
LW3-SB010W-C00WB	50	0.48	1.30	1.03	0.24	0.64	0.33	0.39	0.81	0.69	0.091	0.109	0.1	0.21	0.46	0.28
LW3-SB011E-C00WB	47	0.45	0.92	0.70	0.11	1.02	0.68	0.33	0.76	0.56	0.087	0.109	0.099	0.24	0.56	0.45
LW3-SB011W-C00WB	50	0.48	0.92	0.66	0.33	1.02	0.67	0.39	0.76	0.55	0.087	0.104	0.096	0.34	0.56	0.44
LW3-SB02E-C00WB	50	1.47	2.16	1.86	0.25	0.37	0.30	0.47	0.79	0.59	0.087	0.115	0.1	0.14	0.25	0.19
LW3-SB03E-C00WB	50	1.28	1.98	1.61	0.23	0.33	0.27	0.47	0.64	0.52	0.087	0.12	0.10	0.14	0.23	0.17
LW3-SB03W-C00WB	50	1.28	1.87	1.45	0.23	0.29	0.25	0.47	0.57	0.51	0.11	0.16	0.13	0.14	0.19	0.16
LW3-SB04E-C01WB	50	0.49	1.35	1.17	0.2	0.25	0.22	0.31	0.64	0.53	0.12	0.67	0.22	0.11	0.17	0.14
LW3-SB04W-C00WB	50	0.49	1.39	1.02	0.2	0.25	0.22	0.3	0.64	0.48	0.12	0.67	0.24	0.11	0.17	0.14
LW3-SB05W-C00WB	50	0.49	1.18	0.72	0.22	0.43	0.28	0.3	0.86	0.54	0.12	0.73	0.49	0.13	0.17	0.15
LW3-SB06E-C00WB	50	0.53	1.96	1.47	0.25	1.41	0.54	0.32	1.56	0.75	0.12	0.73	0.55	0.14	0.87	0.32
LW3-SB06W-C00WB	50	0.68	1.96	1.60	0.27	1.41	0.6	0.52	1.56	0.79	0.13	0.70	0.35	0.14	0.87	0.35
LW3-SB07E-C00WB	50	1.20	1.97	1.75	0.33	1.52	1.05	0.50	1.56	1.11	0.13	0.73	0.27	0.24	0.93	0.65
LW3-SB07W-C00WB	50	1.20	1.97	1.76	0.33	1.52	1.15	0.50	1.56	1.21	0.14	0.22	0.18	0.26	0.93	0.71
LW3-SB08E-C00WB	41	0.87	2.66	1.41	0.46	1.45	0.83	0.48	1.73	0.91	0.13	0.19	0.16	0.17	0.89	0.43
LW3-SB08W-C00WB	50	0.87	1.97	1.24	0.46	1.52	0.84	0.43	1.53	0.72	0.087	0.12	0.10	0.17	0.93	0.34
LW3-SB09E-C00WB	50	1.01	1.36	1.22	0.24	1.02	0.67	0.43	0.76	0.53	0.11	0.16	0.14	0.19	0.25	0.22
LW3-SB09W-C00WB	50	0.89	1.36	1.15	0.58	1.02	0.83	0.43	0.54	0.49	0.13	0.17	0.15	0.17	0.25	0.21

Table B1-3f
Sediment SWACs used for Smallmouth Bass in the Mechanistic Model – Dioxin and Furan Congeners
Portland Harbor Superfund Site
Portland, Oregon

Sample ID	Count	1,2,3,7,8-PentaCDD (pg/g dw)			2,3,7,8-TetraCDD (pg/g dw)			1,2,3,4,7,8-HexaCDF (pg/g dw)			2,3,4,7,8-PentaCDF (pg/g dw)			2,3,7,8-TetraCDF (pg/g dw)		
		Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean
LWG0103R014TSSBWBC00	50	0.056	0.15	0.093	0.022	0.062	0.037	0.29	2.1	0.74	0.15	0.95	0.36	0.42	0.96	0.58
LWG0104R023TSSBWBC10	50	0.090	0.15	0.13	0.033	0.057	0.049	0.46	3.6	2.0	0.20	0.96	0.56	0.46	0.60	0.51
LWG0104R023TSSBWBC20	50	0.056	0.15	0.12	0.022	0.057	0.047	0.29	3.6	1.8	0.15	0.96	0.51	0.42	0.60	0.50
LWG0104R023TSSBWBC30	50	0.056	0.15	0.12	0.022	0.057	0.047	0.29	3.6	1.8	0.15	0.96	0.52	0.42	0.60	0.50
LWG0105R006TSSBWBC00	30	0.10	0.18	0.13	0.040	0.044	0.041	2.0	3.9	2.7	0.65	1.1	0.83	0.51	1.1	0.77
LWG0106R024TSSBWBC00	10	0.14	0.21	0.18	0.030	0.044	0.039	2.0	3.2	2.4	0.65	1.4	0.89	0.78	1.8	1.2
LWG0107R009TSSBWBC10	50	0.12	1.6	1.1	0.039	0.77	0.50	6.7	860	530	1.3	130	79	2.0	190	120
LWG0107R009TSSBWBC20	50	0.13	1.6	1.1	0.037	0.77	0.52	3.2	860	530	1.4	130	79	1.73	190	120
LWG0107R009TSSBWBC30	50	0.21	1.6	1.2	0.037	0.77	0.58	3.2	860	480	1.4	130	71	1.73	190	100
LWG0108R010TSSBWBC10	4	0.18	0.18	0.18	0.064	0.064	0.064	2.5	2.5	2.5	0.41	0.41	0.41	0.27	0.27	0.27
LWG0108R010TSSBWBC20	5	0.18	0.18	0.18	0.064	0.064	0.064	2.5	2.5	2.5	0.41	0.41	0.41	0.27	0.27	0.27
LWG0108R010TSSBWBC30	5	0.18	0.18	0.18	0.064	0.064	0.064	2.5	2.5	2.5	0.41	0.41	0.41	0.27	0.27	0.27
LWG0108R032TSSBWBC00	30	0.11	1.4	0.36	0.039	0.68	0.14	0.64	800	330	0.29	120	47	0.41	170	70
LWG0109R006TSSBWBC00	20	0.11	0.18	0.15	0.040	0.18	0.13	0.64	1.3	0.99	0.29	0.55	0.41	0.41	0.54	0.47
LW3-SB010E-C00WB	50	0.18	0.36	0.30	0.047	0.18	0.077	0.60	1.4	1.1	0.18	0.67	0.56	0.28	0.54	0.39
LW3-SB010W-C00WB	50	0.22	0.36	0.30	0.047	0.17	0.080	0.61	1.4	1.2	0.19	0.67	0.59	0.28	0.54	0.40
LW3-SB011E-C00WB	47	0.026	0.29	0.21	0.018	0.14	0.11	0.05	0.7	0.49	0.023	0.26	0.16	0.032	0.39	0.29
LW3-SB011W-C00WB	50	0.18	0.34	0.26	0.047	0.14	0.094	0.38	1.1	0.69	0.14	0.59	0.26	0.23	0.39	0.36
LW3-SB02E-C00WB	50	0.072	0.14	0.11	0.036	0.062	0.050	0.84	1.8	1.3	0.48	0.95	0.72	0.58	0.96	0.82
LW3-SB03E-C00WB	50	0.056	0.14	0.094	0.022	0.062	0.041	0.29	1.8	0.94	0.15	0.95	0.52	0.42	0.96	0.71
LW3-SB03W-C00WB	50	0.056	0.11	0.082	0.022	0.050	0.034	0.29	1.2	0.66	0.15	0.69	0.36	0.42	0.86	0.59
LW3-SB04E-C01WB	50	0.060	0.15	0.12	0.023	0.057	0.048	0.30	3.5	1.8	0.15	0.93	0.50	0.42	0.60	0.50
LW3-SB04W-C00WB	50	0.10	0.15	0.13	0.040	0.057	0.050	0.63	3.7	2.6	0.23	1.0	0.71	0.46	0.60	0.51
LW3-SB05W-C00WB	50	0.10	0.18	0.13	0.040	0.049	0.043	2.0	3.9	2.9	0.65	1.1	0.85	0.49	1.1	0.70
LW3-SB06E-C00WB	50	0.14	1.6	0.60	0.030	0.77	0.26	2.0	860	40	0.65	130	7.2	0.73	190	9.8
LW3-SB06W-C00WB	50	0.14	1.6	0.69	0.030	0.77	0.30	2.0	860	79	0.65	130	13	0.73	190	18
LW3-SB07E-C00WB	50	0.13	1.6	1.2	0.041	0.77	0.61	6.7	860	510	2.4	130	76	2.3	190	110
LW3-SB07W-C00WB	50	0.13	1.6	1.1	0.037	0.77	0.51	3.2	860	540	1.4	130	79	1.7	190	120
LW3-SB08E-C00WB	41	0.11	1.4	0.41	0.039	0.68	0.17	0.64	800	360	0.29	120	52	0.41	170	77
LW3-SB08W-C00WB	50	0.11	1.5	0.35	0.039	0.72	0.18	0.64	830	220	0.29	120	32	0.41	180	47
LW3-SB09E-C00WB	50	0.14	0.32	0.20	0.078	0.18	0.15	0.72	1.4	1.3	0.31	0.67	0.55	0.40	0.54	0.50
LW3-SB09W-C00WB	50	0.11	0.19	0.16	0.066	0.18	0.15	0.64	1.3	1.1	0.29	0.56	0.46	0.41	0.54	0.48

Table B1-4
Spatially Weighted Average Concentrations for Chemicals in Sediment
Portland Harbor Superfund Site
Portland, Oregon

Chemical	Detection Frequency	SWAC (µg/kg-dw)
Antimony	1023/1372	620
Lead	1560/1575	24,000
Aldrin	252/1,034	0.47
Benzo(a)anthracene	1585/1661	53,000[a]
Benzo(a)pyrene	1581/1661	68,000[a]
Dibenz(a,h)anthracene	1357/1661	6900[a]
Chlordane	734/1,083	2.4
4,4′-DDD	951/1,128	6.3
4,4′-DDE	928/1,125	3.4
4,4′-DDT	769/1,113	14.8
Sum DDD	969/1,128	8.9
Sum DDE	933/1,125	4.22
Sum DDT	856/1,127	17.3
DDx	1,021/1,128	30.3
Dieldrin	246/1,078	0.54
α-HCH	206/1,072	0.27
β-HCH	443/1,083	1.28
γ-HCH	182/1,083	0.71
Heptachlor	72/1,083	0.22
Heptachlor epoxide	87/1,082	0.29
PCB 17	246/253	1.07
PCB 77	254/266	0.18
PCB 118	40/96	3.28
PCB 126	251/266	0.018
PCB 167	264/266	0.230
Total PCBs	872/1,103	92.6
1,2,3,7,8-PentaCDD	128 / 219	0.00025
2,3,7,8-TetraCDD	41 / 219	0.00010
1,2,3,4,7,8-HexaCDF	197 / 219	0.0027
2,3,4,7,8-PentaCDF	173 / 219	0.012
2,3,7,8-TetraCDF	145 / 219	0.017
Tributyltin ion	333/358	12.2[a]

a Value presented as µg/kg-OC

Table B1-5
BSAR Relationships for Field Clams
Portland Harbor Superfund Site
Portland, Oregon

Chemical	BSAR	Model Type	Correction Factor	r^2
Arsenic	No relationship	NA	NA	NA
Cadmium	No relationship	NA	NA	NA
Copper	No relationship	NA	NA	NA
Zinc	No relationship	NA	NA	NA
Benzo(a)anthracene	$\ln(C_{tiss}) = 0.588 \times \ln(C_{sed}) + \ln(CF) – 0.97$	log-log	1.70	0.40
Benzo(a)pyrene	$\ln(C_{tiss}) = 0.60 \times \ln(C_{sed}) + \ln(CF) – 2.47$	log-log	2.31	0.36
Benzo(b)fluoranthene	No relationship	NA	NA	NA
Benzo(k)fluoranthene	$\ln(C_{tiss}) = 0.707 \times \ln(C_{sed}) + \ln(CF) – 2.55$	log-log	2.13	0.43
Chrysene	$\ln(C_{tiss}) = 0.486 \times \ln(C_{sed}) + \ln(CF) – 0.66$	log-log	1.57	0.34
Dibenz(a,h)anthracene	No relationship	NA	NA	NA
Indeno(1,2,3-cd)pyrene	No relationship	NA	NA	NA
BEHP	Insufficient data	NA	NA	NA
Dibutyl phthalate	Insufficient data	NA	NA	NA
Tributyltin	No relationship	NA	NA	NA
Hexachlorobenzene	No relationship	NA	NA	NA

Table B1-6
BSAR Relationships for Crayfish
Portland Harbor Superfund Site
Portland, Oregon

Chemical	BSAR	Model Type	Correction Factor	r^2
Arsenic	No relationship	NA	NA	NA
Copper	No relationship	NA	NA	NA
Lead	No relationship	NA	NA	NA
Benzo(a)anthracene	Insufficient data	NA	NA	NA
Benzo(a)pyrene	$\ln(C_{tiss}) = 0.983 \times \ln(C_{sed}) + \ln(CF) – 5.54$	log-log	1.09	0.92
Benzo(b)fluoranthene	Insufficient data	NA	NA	NA
Benzo(k)fluoranthene	Insufficient data	NA	NA	NA
Chrysene	Insufficient data	NA	NA	NA
Dibenz(a,h)anthracene	Insufficient data	NA	NA	NA
Indeno(1,2,3-cd)pyrene	Insufficient data	NA	NA	NA
Tributyltin	No relationship	NA	NA	NA
Hexachlorobenzene	No relationship	NA	NA	NA
Pentachlorophenol	Insufficient data	NA	NA	NA

Table B1-7
BSAR Relationships for Laboratory Worms
Portland Harbor Superfund Site
Portland, Oregon

Chemical	BSAR	Model Type	Correction Factor	r^2
Arsenic	No relationship	NA	NA	NA
Cadmium	No relationship	NA	NA	NA
Copper	No relationship	NA	NA	NA
Zinc	No relationship	NA	NA	NA
Benzo(a)pyrene	$\ln(C_{tiss}) = 0.618 \times \ln(C_{sed}) + \ln(CF) - 0.48$	log-log	1.8	0.39
Tributyltin	$\ln(C_{tiss}) = 0.968 \times \ln(C_{sed}) + \ln(CF) - 1.67$	log-log	1.5	0.66

Table B1-8
BSAR Relationships for Sculpin
Portland Harbor Superfund Site
Portland, Oregon

Chemical	BSAR	Model Type	Correction Factor	r^2
Cadmium	No relationship	NA	NA	NA
Copper	No relationship	NA	NA	
Lead	$\ln(C_{tiss}) = 0.610 \times \ln(C_{sed}) + \ln(CF) - 0.486$	log-log	1.29	0.486
Tributyltin	No relationship	NA	NA	NA

Table B1-9
BSAR Relationships for Smallmouth Bass
Portland Harbor Superfund Site
Portland, Oregon

Chemical	BSAR	Model Type	Correction Factor	r^2
Antimony	No relationship	NA	NA	NA
Arsenic	No relationship	NA	NA	NA
Lead	No relationship	NA	NA	NA
Mercury	No relationship	NA	NA	NA
Selenium	No relationship	NA	NA	NA
Zinc	No relationship	NA	NA	NA
Benzo(a)anthracene	No relationship	NA	NA	NA
Benzo(a)pyrene	No relationship	NA	NA	NA
Dibenz(a,h)anthracene	Insufficient data	NA	NA	NA
BEHP	No relationship[c]	NA	NA	NA
Hexachlorobenzene	No relationship[c]	NA	NA	NA

Table B1-10
BSAFs for Large-Home-Range Species
Portland Harbor Superfund Site
Portland, Oregon

Chemical	BSAF						
	Black Crappie	**Brown Bullhead**	**Carp**	**Lamprey**	**Largescale Sucker**	**Northern Pikeminnow**	**Peamouth**
Antimony	0.0008	0.0008	0.0035				
Arsenic	NM	NM	NM				
Copper				NM	NM		
Lead	0.00027	0.00102	0.0082		0.0049	0.00036	0.11
Mercury	NM	NM	NM		NM	NM	NM
Selenium	NM	NM	NM				
Zinc	NM	NM	NM				
Benzo(a)anthracene	NTD	0.014	0.0017				
Benzo(a)pyrene	NTD	0.011	0.0013				
Dibenz(a,h)anthracene	NTD	0.11	0.013				
BEHP	NM	NM	NM				
Tributyltin			0.005				
Hexachlorobenzene	0.3	2.02	0.24				

Table B1-11
Components in the Arnot and Gobas Food Web Model
Portland Harbor Superfund Site
Portland, Oregon

Model component	Symbol	Unit	Equation	Note
Biological				
Chemical concentration in the organism	C_B	µg/kg ww	$C_B = \{k_1 \times (m_O \times C_{WD}+m_P \times C_{WD.P})+k_D \times \Sigma P_i \times C_{D,i}\} / (k_2+k_E+k_G+k_M)$	Species-specific model output
Chemical concentration in prey item i	$C_{D,i}$	µg/kg ww	Same as above	Species-specific model output
Rate constant for aqueous uptake (fish, invertebrates, and zooplankton)	k_1	L/kg/day	$k_1 = E_W \times G_V/W_B$	Calculated in model
Rate constant for aqueous uptake (algae, phytoplankton, and aquatic macrophytes)	k_1	L/kg/day	$K_1 = (A+(B/K_{OW}))^{-1}$	Calculated in model
Rate constant for chemical elimination via the respiratory area	k_2	day^{-1}	$k_2 = k_1/K_{BW}$	Calculated in model
Rate constant for chemical uptake via ingestion and digestion of food and water	k_D	kg food/kg organism/day	$k_D = E_D \times G_D/W_B$	Calculated in model
Rate constant for chemical elimination via excretion into feces	k_E	day^{-1}	$k_E = G_F \times E_D \times K_{GB}/W_B$	Calculated in model
Rate constant for growth of aquatic organisms	k_G	day^{-1}	$k_G = 0.0005 \times W_B^{-0.2}$	Calculated in model
Rate constant for metabolic transformation of the chemical	k_M	day^{-1}	Chemical-specific	

Table B1-11
Components in the Arnot and Gobas Food Web Model
Portland Harbor Superfund Site
Portland, Oregon

Model component	Symbol	Unit	Equation	Note
Dietary chemical transfer efficiency	E_D	unitless	$E_D = (3 \times 10^{-7} \times K_{OW}+2.0)^{-1}$	Calculated in model
Respiratory surface chemical uptake efficiency	E_W	unitless	$E_W = (1.85+(155/K_{OW}))^{-1}$	Calculated in model
Feeding rate – filter-feeders	G_D	kg/d	$G_D = G_V \times C_S \times \sigma$	Calculated in model
Feeding rate – other species	G_D	kg/d	$G_D = 0.022 \times W_B^{0.85} \times e^{(0.06 \times T)}$	Calculated in model
Fecal elimination rate	G_F	kg/d	$G_F = \{((1-\varepsilon_L) \times \nu_{LD})+(1-\varepsilon_N) \times \nu_{ND}+(1-\varepsilon_W)\} \times G_D$	Calculated in model
Gill ventilation rate	G_V	L/d	$G_V = 1{,}400 \times W_B^{0.65}/C_{OX}$	calculated in model
Organism-water partition coefficient on a wet-weight basis	K_{BW}	unitless	$K_{BW} = k_1/k_2$ $=\nu_{LB} \times K_{OW}+\nu_{NB} \times \beta \times K_{OW}+\nu_{WB}$	Calculated in model
Phytoplankton-water partition coefficient on a wet-weight basis	K_{PW}	unitless	$K_{PW} = \nu_{LP} \times K_{OW}+\nu_{NP} \times 0.35 \times K_{OW}+\nu_{NP}$	Calculated in model
Partition coefficient of the chemical between the contents of the gastrointestinal tract and the organism	K_{GB}	unitless	$K_{GB} = (\nu_{LG} \times K_{OW}+\nu_{NG} \times \beta \times K_{OW}+\nu_{WG})/(\nu_{LB} \times K_{OW}+\nu_{NB} \times \beta \times K_{OW}+\nu_{WB})$	Calculated in model
Lipid fraction of gut contents	ν_{LG}	kg lipid/kg digesta ww	$\nu_{LG} = (1-\varepsilon_L) \times \nu_{LD}/[(1-\varepsilon_L) \times \nu_{LD}+(1-\varepsilon_N) \times \nu_{ND}+(1-\varepsilon_W) \times \nu_{WD}]$	Calculated in model
NLOM fraction of gut contents	ν_{NG}	kg NLOM/kg digesta ww	$\nu_{NG} = (1-\varepsilon_N) \times \nu_{ND}/[(1-\varepsilon_L) \times \nu_{LD}+(1-\varepsilon_N) \times \nu_{ND}+(1-\varepsilon_W) \times \nu_{WD}]$	Calculated in model
Water fraction of gut contents	ν_{WG}	kg water/kg digesta ww	$\nu_{WG} = (1-\varepsilon_W) \times \nu_{WD}/[(1-\varepsilon_L) \times \nu_{LD} +(1-\varepsilon_N) \times \nu_{ND}+(1-\varepsilon_W) \times \nu_{WD}]$	Calculated in model

Table B1-11
Components in the Arnot and Gobas Food Web Model
Portland Harbor Superfund Site
Portland, Oregon

Model component	Symbol	Unit	Equation	Note
Overall lipid content of the diet	ν_{LD}	kg lipid/kg food ww	$\nu_{LD} = \Sigma P_i \times \nu_{LB,i}$	Calculated in model
Overall NLOM content of the diet	ν_{ND}	kg NLOM/kg food ww	$\nu_{ND} = \Sigma P_i \times \nu_{NB,i}$	Calculated in model
Overall water content of the diet	ν_{WD}	kg water/kg food ww	$\nu_{WD} = \Sigma P_i \times \nu_{WB,i}$	Calculated in model
Environmental				
Freely dissolved chemical concentration in the porewater	$C_{WD,P}$	ng/L	$D_{WD,P} = C_{S,OC} \times \delta_{OCS}/K_{OC}$	Calculated in model
Chemical concentration in the sediment, organic carbon normalized	$C_{S,OC}$	µg/kg dw OC	$C_{S,OC} = C_S/OC_{sed}$	Calculated in model
Freely dissolved chemical concentration in the water (total PCBs as congeners and 4,4′-DDE)	C_{WD}	ng/L	$C_{WD} = C_{WT} \times \phi$	Calculated in model
Bioavailable solute fraction	ϕ	unitless	$\phi = 1/1 + \chi_{POC} \times D_{POC} \times \alpha_{POC} \times K_{OW} + \chi_{POC}$ x $\alpha_{DOC} \times K_{OW})$	Calculated in model
Dissolved oxygen concentration of water	C_{OX}	mg O2/L	$C_{OX} = (-0.24 \times T + 14.04) \times 0.9$	Calculated in model
Organic carbon-water partition coefficient	Log K_{OC}	unitless	Log K_{OC} = Log$(0.35 \times 10^{\mathrm{Log}\ K_{ow}})$	Calculated in model

Table B1-12a
Surface Water Concentrations
Portland Harbor Superfund Site
Portland, Oregon

		Dissolved Water Concentration (ng/L)[a]	
Chemical	**Detection Frequency**	**Mean**	**Standard Error**
PCB 17	26/26	0.00434	0.00059
PCB 77	24/26	0.00026	0.00003
PCB 118	26/26	0.00282	0.00025
PCB 126	5/26	0.000013	0.000001
PCB 167	22/26	0.0001	0.0000082
Total PCBs	26/26	0.217	0.024
4,4′-DDD	26/26	0.049	0.009
4,4′-DDE	26/26	0.031	0.0028
4,4′-DDT	26/26	0.017	0.0021
Aldrin	23/26	0.0022	0.00022
α-HCH	26/26	0.027	0.0040
β-HCH	20/26	0.0052	0.00042
Dieldrin	26/26	0.067	0.0092
γ-HCH	26/26	0.025	0.0013
Heptachlor	3/26	0.00021	0.000016
Heptachlor epoxide	26/26	0.0071	0.00044
DDD	26/26	0.070	0.013
DDE	26/26	0.032	0.0029
DDT	26/26	0.022	0.0024
Chlordane	26/26	0.029	0.0019

[a] The standard error of the data were used to describe the standard deviation of estimates of the mean.

Table B1-12b
Surface Water Concentrations – Dioxins/Furans
Portland Harbor Superfund Site
Portland, Oregon

		Dissolved Water Concentration (ng/L)[a]			
		Option 1		Option 2	
Chemical	**Detection Frequency**	**Mean**	**Standard Error**	**Mean**	**Standard Error**
1,2,3,7,8-PentaCDD	8 / 26	4.3×10^{-6}	2.9×10^{-6}	1.5×10^{-6}	5.1×10^{-7}
2,3,7,8-TetraCDD	1 / 26	2.7×10^{-6}	1.2×10^{-6}	8.3×10^{-7}	2.4×10^{-7}
1,2,3,4,7,8-HexaCDF	7 / 26	5.9×10^{-6}	1.7×10^{-6}	3.6×10^{-6}	1.2×10^{-6}
2,3,4,7,8-PentaCDF	7 / 26	3.5×10^{-6}	1.2×10^{-6}	2.4×10^{-6}	8.6×10^{-7}
2,3,7,8-TetraCDF	15 / 26	5.5×10^{-6}	1.2×10^{-6}	na	na

[a] The standard error of the data were used to describe the standard deviation of estimates of the mean.

Table B1-13a
K_{OW} Values for Individual Chemicals
Portland Harbor Superfund Site
Portland, Oregon

Chemical	log K_{OW} Values	
	Nominal Value	Distribution Range
PCB 17	5.70	4.60 – 5.76
PCB 77	6.22	5.62 – 7.87
PCB 118	6.85	6.24 – 7.42
PCB 126	6.83	6.38 – 7.00
PCB 167	7.48	6.82 – 7.62
Total PCBs	7.40	6.09 – 7.84
4,4′-DDD	6.05	4.82 – 6.33
4,4′-DDE	6.90	4.28 – 6.97
4,4′-DDT	6.72	3.98 – 8.31
Sum DDD	6.00	4.8 – 6.31
Sum DDE	6.80	4.22 – 6.87
Sum DDT	6.58	3.98 – 8.19
DDx	6.65	4.34 – 7.08
Aldrin	6.39	3.01 – 7.50
α-HCH	3.78	3.19 – 4.57
β-HCH	3.78	3.19 – 4.26
Dieldrin	5.37	2.60 – 6.20
1,2,3,7,8-PentaCDD	7.06	6.49 – 7.56
2,3,7,8-TetraCDD	6.38	5.38 – 8.93
1,2,3,4,7,8-HexaCDF	7.66	6.92 – 7.92
2,3,4,7,8-PentaCDF	6.95	6.56 – 7.82
2,3,7,8-TetraCDF	6.30	5.82 – 7.70

Table B1-13b
K_{OW} Values for Components of Calculated Chemical Mixtures
Portland Harbor Superfund Site
Portland, Oregon

Chemical	Average Contribution (fraction)[a]	Log K_{OW}		
		Primary	Minimum	Maximum
Total PCBs				
PCB 001	0.0014	4.61	3.75	4.80
PCB 002	0.00002	4.55	3.75	4.81
PCB 003	0.00013	4.56	4.26	4.90
PCB 004	0.0039	5.13	3.02	5.70
PCB 005	0.00002	5.22	4.82	5.22
PCB 006	0.0003	5.07	4.84	5.07
PCB 007	0.00003	5.15	4.67	5.30
PCB 008	0.0012	5.07	4.47	5.51
PCB 009	0.00006	5.14	4.67	5.30
PCB 010	0.0001	5.23	4.93	5.31
PCB 011	0.0018	5.01	5.01	5.4
PCB 012 & 013	0.00009	5.09	5.05	5.51
PCB 014	0.00001	5.11	5.05	5.63
PCB 015	0.00062	5.02	4.82	5.58
PCB 016	0.0014	5.75	4.15	5.75
PCB 017	0.0029	5.70	4.60	5.76
PCB 018 & 030	0.0036	5.76	3.89	6.22
PCB 019	0.0027	5.74	3.75	5.74
PCB 020 & 028	0.0097	5.66	4.69	5.75
PCB 021 & 033	0.0024	5.75	5.48	5.98
PCB 022	0.0023	5.69	4.84	5.69
PCB 023	0.00001	5.81	5.44	5.81
PCB 024	0.00004	5.84	4.52	5.84
PCB 025	0.00061	5.62	5.51	5.69
PCB 026 & 029	0.0013	5.69	5.51	6.25
PCB 027	0.00093	5.70	5.24	5.70
PCB 031	0.00513	5.61	5.30	6.33
PCB 032	0.00151	5.70	4.60	5.80
PCB 034	0.00004	5.63	5.51	5.71
PCB 035	0.00006	5.61	5.53	5.82
PCB 036	0.00004	5.57	4.15	5.88
PCB 037	0.0015	5.62	4.94	6.00
PCB 038	0.00002	5.78	5.48	5.78
PCB 039	0.00007	5.58	5.58	5.89
PCB 040 & 041 & 071	0.0062	6.35	4.63	6.35

Table B1-13b
K_{OW} Values for Components of Calculated Chemical Mixtures
Portland Harbor Superfund Site
Portland, Oregon

Chemical	Average Contribution (fraction)[a]	Log K_{OW}		
		Primary	Minimum	Maximum
PCB 042	0.0041	6.31	5.72	6.34
PCB 043	0.00051	6.34	5.75	6.34
PCB 044 & 047 & 065	0.022	6.34	4.79	7.87
PCB 045 & 051	0.003	6.32	4.84	6.34
PCB 046	0.00038	6.36	4.84	6.36
PCB 048	0.0024	6.32	5.56	6.34
PCB 049 & 069	0.013	6.28	5.73	6.41
PCB 050 & 053	0.0038	6.32	5.39	7.87
PCB 052	0.02	6.20	3.91	6.34
PCB 054	0.00050	6.34	4.16	7.13
PCB 055	0.0001	6.31	5.86	6.34
PCB 056	0.0037	6.29	5.85	6.34
PCB 057	0.00008	6.28	5.91	6.34
PCB 058	0.00007	6.25	5.91	6.34
PCB 059 & 062 & 075	0.0015	6.37	5.79	6.37
PCB 060	0.0039	6.31	5.33	7.87
PCB 061 & 070 & 074 & 076	0.025	6.31	5.86	6.79
PCB 063	0.001	6.28	5.91	6.34
PCB 064	0.0063	6.30	5.76	6.34
PCB 066	0.02	6.23	5.8	6.34
PCB 067	0.00036	6.24	5.93	6.4
PCB 068	0.00026	6.17	5.99	6.34
PCB 072	0.00027	6.16	5.98	7.87
PCB 073	0.00014	6.26	5.80	6.34
PCB 077	0.001	6.22	5.62	7.87
PCB 078	0.00002	6.23	5.95	6.35
PCB 079	0.00031	6.18	6.00	6.42
PCB 080	0.00002	6.13	6.13	6.85
PCB 081	0.00004	6.23	5.96	6.64
PCB 082	0.0017	7.00	6.05	7.00
PCB 083 & 099	0.028	6.92	6.05	7.21
PCB 084	0.0036	6.95	5.60	6.98
PCB 085 & 116 & 117	0.0069	7.04	6.23	7.04
PCB 086 & 087 & 097 & 108 & 119 & 125	0.017	6.93	5.45	8.71
PCB 088 & 091	0.0046	6.95	5.87	7.51

Table B1-13b
K_{OW} Values for Components of Calculated Chemical Mixtures
Portland Harbor Superfund Site
Portland, Oregon

Chemical	Average Contribution (fraction)[a]	Log K_{OW}		
		Primary	Minimum	Maximum
PCB 089	0.00018	6.99	5.6	6.99
PCB 090 & 101 & 113	0.037	6.87	5.58	6.98
PCB 092	0.0077	6.88	6.05	6.98
PCB 093 & 095 & 098 & 100 & 102	0.024	6.94	5.18	6.98
PCB 094	0.00034	6.95	6.04	6.98
PCB 096	0.00026	6.94	5.54	6.98
PCB 103	0.00087	6.89	5.92	8.71
PCB 104	0.0001	6.96	5.37	8.71
PCB 105	0.013	6.91	4.97	7.14
PCB 106	0.00003	6.95	6.29	7.22
PCB 107 & 124	0.00087	6.85	6.35	6.98
PCB 109	0.0033	6.96	6.27	6.98
PCB 110 & 115	0.028	6.94	6.20	6.98
PCB 111	0.00008	6.84	6.39	8.27
PCB 112	0.00005	6.94	6.24	6.98
PCB 114	0.001	6.95	6.29	6.98
PCB 118	0.04	6.85	6.24	7.42
PCB 120	0.0003	6.80	5.22	6.98
PCB 121	0.00009	6.88	6.19	6.98
PCB 122	0.00022	6.90	6.29	6.98
PCB 123	0.00074	6.83	6.19	6.98
PCB 126	0.00008	6.83	6.38	7.00
PCB 127	0.00014	6.79	6.42	6.98
PCB 128 & 166	0.0072	7.58	6.40	7.62
PCB 129 & 138 & 160 & 163	0.083	7.58	6.39	7.90
PCB 130	0.0035	7.60	6.57	7.62
PCB 131	0.00035	7.63	6.38	7.63
PCB 132	0.01	7.58	6.20	7.62
PCB 133	0.0019	7.56	6.60	7.69
PCB 134 & 143	0.0019	7.62	6.20	7.62
PCB 135 & 151 & 154	0.024	7.54	5.94	7.62
PCB 136	0.0048	7.54	4.91	8.35
PCB 137	0.0028	7.58	6.71	7.71
PCB 139 & 140	0.00098	7.59	6.49	7.62
PCB 141	0.0096	7.56	6.64	9.54
PCB 142	0.00002	7.73	6.41	7.73

Table B1-13b
K_{OW} Values for Components of Calculated Chemical Mixtures
Portland Harbor Superfund Site
Portland, Oregon

Chemical	Average Contribution (fraction)[a]	Log K_{OW}		
		Primary	Minimum	Maximum
PCB 144	0.0024	7.54	6.29	7.62
PCB 145	0.00001	7.61	6.25	7.62
PCB 146	0.018	7.53	6.57	7.62
PCB 147 & 149	0.04110	7.53	6.14	7.62
PCB 148	0.00031	7.55	5.74	7.62
PCB 150	0.00019	7.54	6.16	7.62
PCB 152	0.0001	7.58	6.09	7.62
PCB 153 & 168	0.11	7.53	6.34	8.35
PCB 155	0.00005	7.57	6.01	7.62
PCB 156	0.0074	7.56	6.70	7.84
PCB 156 & 157	0.0068	7.55	6.70	7.84
PCB 157	0.0011	7.54	6.73	7.62
PCB 158	0.0065	7.57	6.69	7.69
PCB 159	0.00045	7.51	6.76	7.62
PCB 161	0.00001	7.53	6.66	7.62
PCB 162	0.00023	7.51	6.66	7.62
PCB 164	0.0033	7.53	6.63	7.62
PCB 165	0.00011	7.50	6.57	7.62
PCB 167	0.0032	7.48	6.82	7.62
PCB 169	0.00002	7.46	7.01	7.62
PCB 170	0.02	8.28	6.83	8.28
PCB 171 & 173	0.0062	8.31	6.68	8.31
PCB 172	0.0038	8.24	6.85	8.27
PCB 174	0.01	8.23	6.85	8.27
PCB 175	0.00091	8.22	6.92	8.27
PCB 176	0.0017	8.22	6.55	8.27
PCB 177	0.012	8.23	6.73	8.27
PCB 178	0.0059	8.19	6.85	8.27
PCB 179	0.0065	8.19	6.41	8.27
PCB 180 & 193	0.068	8.20	6.56	8.27
PCB 181	0.00023	8.29	7.06	8.29
PCB 182	0.00013	8.23	6.92	8.27
PCB 183 & 185	0.018	8.24	6.78	8.27
PCB 184	0.00004	8.21	6.65	8.27
PCB 186	0.000009	8.34	6.69	8.34
PCB 187	0.044	8.17	6.76	8.27

Table B1-13b
K_{OW} Values for Components of Calculated Chemical Mixtures
Portland Harbor Superfund Site
Portland, Oregon

Chemical	Average Contribution (fraction)[a]	Log K_{OW}		
		Primary	Minimum	Maximum
PCB 188	0.00009	8.19	6.78	8.27
PCB 189	0.00081	8.18	6.75	8.27
PCB 190	0.005	8.30	7.05	8.3
PCB 191	0.0011	8.20	7.12	8.27
PCB 192	0	8.25	7.09	8.27
PCB 194	0.0086	8.91	6.94	9.35
PCB 195	0.004	8.98	6.95	8.98
PCB 196	0.0052	8.90	7.42	8.91
PCB 197 & 200	0.0010	8.91	7.16	8.91
PCB 198 & 199	0.0099	8.91	7.20	8.91
PCB 201	0.0014	8.86	7.21	8.91
PCB 202	0.0025	8.83	6.98	9.77
PCB 203	0.0068	8.92	6.93	8.92
PCB 204	0.00002	8.94	7.26	8.94
PCB 205	0.00044	8.93	7.47	8.93
PCB 206	0.00228	9.62	7.07	9.62
PCB 207	0.00041	9.61	7.52	9.61
PCB 208	0.00081	9.58	7.69	9.58
PCB 209	0.001	10.3	7.59	11.2
Sum DDD				
2,4′-DDD	0.22	5.93	4.82	6.33
4,4′-DDD	0.77	6.05	4.82	6.33
Sum DDE				
2,4′-DDE	0.043	6.84	4.28	6.97
4,4′-DDE	0.94	6.90	4.28	6.97
Sum DDT				
2,4′-DDT	0.32	6.57	3.98	8.31
4,4′-DDT	0.67	6.72	3.98	8.31
DDx				
2,4′-DDD	0.05	5.93	4.82	6.33
2,4′-DDE	0.02	6.84	4.28	6.97
2,4′-DDT	0.067	6.57	3.98	8.31
4,4′-DDD	0.18	6.05	4.82	6.33
4,4′-DDE	0.55	6.90	4.28	6.97
4,4′-DDT	0.13	6.72	3.98	8.31

Table B1-14
Metabolic Rate Constants (1/day) for Metabolized Chemicals
Portland Harbor Superfund Site
Portland, Oregon

	Selected K_M Values	
Chemical	**Nominal Value**	**Distribution Range**
PCB 77	0.03	0 – 0.3
PCB 126	0.003	0 – 0.03
4,4′-DDT	0.01	0 – 0.1
Sum DDT[b]	0.005[b]	0 – 0.05[b]
1,2,3,7,8-PentaCDD	0.019	0.005 – 0.07
2,3,7,8-TetraCDD	0.013	0.002 – 0.08
1,2,3,4,7,8-HexaCDF	0.06	0 – 0.6
2,3,4,7,8-PentaCDF	0.058	0.009 – 0.3
2,3,7,8-TetraCDF	0.12	0.01 – 0.5

[a] The metabolic rate for sum DDT was estimated as equal to one-half of the metabolic rate selected for 4,4′-DDT although 4,4′-DDT made up more than 50 percent of sum DDT. Sum DDT is the sum of 2,2′-DDT and 4,4′-DDT. The former is not expected to metabolize significantly.

Table B1-15
Study Area-Wide Mean Field-Collected Invertebrates Empirical Tissue Concentrations
Portland Harbor Superfund Site
Portland, Oregon

	Clams		Crayfish	
Chemical	**Detection Frequency**	**Conc (µg/kg ww)**	**Detection Frequency**	**Conc (µg/kg ww)**
Total PCBs	41/41	230	17/32	68
PCB 17	38/38	1.81	12/15	0.052
PCB 77	38/38	0.20	15/15	0.14
PCB 118	38/38	7.03	15/15	4.45
PCB 126	36/38	0.012	15/15	0.0086
PCB 167	38/38	0.861	15/15	0.75
1,2,3,7,8-PentaCDD	19/36	0.00021	15/15	0.0002
2,3,7,8-TetraCDD	4/36	0.00018	15/15	0.00014
1,2,3,4,7,8-HexaCDF	31/36	0.00052	14/15	0.0019
2,3,4,7,8-PentaCDF	24/36	0.00076	15/15	0.0017
2,3,7,8-TetraCDF	32/36	0.0025	15/15	0.0064
4,4′-DDD	41/41	18	10/32	1.4
4,4′-DDE	41/41	17	32/32	5.6
4,4′-DDT	40/41	6	9/32	1.9
Aldrin	37/41	0.38	1/32	0.44
α-HCH	13/41	0.058	2/32	0.44
β-HCH	1/41	0.17	0/32	0.44
Dieldrin	38/41	0.82	5/32	0.44
γ-HCH	33/41	0.092	0/32	0.44
Heptachlor	19/41	0.059	0/32	0.44
Heptachlor epoxide	37/41	0.23	2/32	0.44
Sum DDD	41/41	25	10/32	1.6
Sum DDE	41/41	18	32/32	6.2
Sum DDT	40/41	8.4	21/32	3.9
Total chlordane	41/41	4.2	10/32	1
DDx	41/41	51	32/32	12

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Table B1-16
Study Area-Wide Mean Empirical Fish Tissue Concentrations
Portland Harbor Superfund Site
Portland, Oregon

	Sculpin		Largescale Sucker		Carp		Smallmouth Bass		Northern Pikeminnow	
Chemical	Detection Frequency	Conc (µg/kg ww)	Detection Frequency	Conc (µg/kg ww)	Detection Frequency	Conc (µg/kg ww)	Detection Frequency	Conc (µg/kg ww)	Detection Frequency	Conc (µg/kg ww)
Total PCBs	38/38	690	6/6	880	15/15	2700	32/32	1100	6/6	870
PCB 17	21/21	1.52	na	na	15/15	5.36	32/32	1.23	na	na
PCB 77	21/21	0.28	na	na	14/15	0.24	32/32	0.46	na	na
PCB 118	21/21	0.025	na	na	15/15	26.7	32/32	30.9	na	na
PCB 126	9/21	0.036	na	na	9/15	0.072	25/32	0.056	na	na
PCB 167	21/21	2.06	na	na	15/15	6.37	32/32	3.16	na	na
1,2,3,7,8-PentaCDD	21/21	0.0005	na	na	15/15	0.0014	32/32	0.0014	na	na
2,3,7,8-TetraCDD	21/21	0.00026	na	na	15/15	0.00071	32/32	0.00064	na	na
1,2,3,4,7,8-HexaCDF	21/21	0.0044	na	na	15/15	0.002	32/32	0.0017	na	na
2,3,4,7,8-PentaCDF	21/21	0.0021	na	na	15/15	0.0024	32/32	0.0055	na	na
2,3,7,8-TetraCDF	21/21	0.0087	na	na	15/15	0.0029	32/32	0.0064	na	na
4,4′-DDD	31/38	20	6/6	54	15/15	55	32/32	42	5/6	33
4,4′-DDE	31/38	45	6/6	120	15/15	130	32/32	110	6/6	250
4,4′-DDT	33/38	71	5/6	59	10/15	3.4	27/32	31	1/6	11
Aldrin	10/38	1.1	0/6	2.5	9/15	1.2	15/32	1.1	0/6	4.2
α-HCH	7/38	0.86	0/6	2	9/15	0.78	15/32	0.86	0/6	3.1
β-HCH	16/38	2.5	0/6	2.3	9/15	1.1	8/32	1.3	0/6	3.6
Dieldrin	26/38	4.9	0/6	3.8	9/15	2.7	19/32	4	0/6	5.2
γ-HCH	15/38	1.5	1/6	2.8	9/15	1.2	12/32	1.1	0/6	3.9
Heptachlor	2/38	0.94	0/6	2.5	5/15	1.1	9/32	1.1	0/6	4.2
Heptachlor epoxide	12/38	1.2	0/6	2.1	9/15	0.96	18/32	1	0/6	3.5
Sum DDD	31/38	25	6/6	67	15/15	75	32/32	52	5/6	40
Sum DDE	31/38	47	6/6	120	15/15	130	32/32	120	6/6	260
Sum DDT	34/38	89	5/6	73	10/15	6	27/32	38	2/6	29
Total chlordane	26/38	9.5	2/6	11	12/15	13	20/32	10	0/6	6.4
DDx	38/38	160	6/6	270	15/15	210	32/32	210	6/6	330

Table B1-17
SPAFs for Calibration Chemicals Based on Calibrated Non-Chemical-Specific Parameters and Uncalibrated Chemical-Specific Parameters
Portland Harbor Superfund Site
Portland, Oregon

Parameter Set	SPAFs[a]							Average SPAF
	BIF	EIC	SCL	LSS	CAR	SMB	NPM	
Total PCBs								
Uncalibrated	3.9	**4.4**	**1.3**	**1.1**	3.3	**3.8**	**2.6**	2.9
Post-calibration[b]	3.1	**3.7**	**1.1**	1.0	3.0	**2.5**	**2.1**	2.4
PCB 17								
Uncalibrated	4.9	**10.0**	**1.1**	NA	**1.6**	**5.1**	NA	4.5
Post-calibration[b]	4.3	**8.7**	**1.1**	NA	1.4	**3.9**	NA	3.9
PCB 118								
Uncalibrated	3.2	**2.3**	**1.4**	NA	**1.6**	**6.9**	NA	3.1
Post-calibration[b]	2.5	**1.9**	**1.2**	NA	**1.8**	**4.5**	NA	2.4
PCB 167								
Uncalibrated	8.0	1.2	1.1	NA	4.0	**2.4**	NA	3.3
Post-calibration[b]	6.1	1.4	1.4	NA	3.6	**1.5**	NA	2.8
4,4′-DDE								
Uncalibrated	3.8	**2.8**	**1.2**	1.5	1.9	**2.8**	1.5	2.2
Post-calibration[b]	3.3	**2.6**	**1.1**	1.6	1.7	**2.0**	1.6	2.0
DDx								
Uncalibrated	2.0	**7.5**	**2.0**	**1.8**	**2.1**	**9.2**	**3.2**	4.0
Post-calibration[b]	1.7	**6.5**	**1.8**	**1.7**	**2.4**	**6.3**	**2.9**	3.3
1,2,3,7,8-PentaCDD								
Uncalibrated	2.0	**1.2**	1.7	ND	9.4	7.3	ND	4.3
2,3,7,8-TetraCDD								
Uncalibrated	1.9	**1.2**	**1.2**	ND	4.4	1.9	ND	2.1
1,2,3,4,7,8-HexaCDF								
Uncalibrated	8.0	37	74	ND	73	103	ND	59
2,3,4,7,8-PentaCDF								
Uncalibrated	**1.9**	**1.7**	**2.1**	ND	1.2	2.3	ND	1.9
2,3,7,8-TetraCDF								
Uncalibrated	**2.3**	**1.6**	**2.6**	ND	**4.0**	**4.3**	ND	3.0

[a] **SPAFs** are shown in **bold** and indicate that the model was over-predicting for this species-chemical combination.

[b] Calibrated values were used for non-chemical specific parameters. Nominal values were used for the chemical-specific parameters.

Post-calibration for dioxin/furans was not performed in this step.

Table B1-18
SPAFs for Calibration Chemicals for Smallmouth Bass
Portland Harbor Superfund Site
Portland, Oregon

Parameter Set	Using Mean 1-RM SWAC			Using Minimum 1-RM SWAC			Using Maximum 1-RM SWAC		
	Average SPAF	Count SPAF<5	Count SPAF<10	Average SPAF	Count SPAF<5	Count SPAF<10	Average SPAF	Count SPAF<5	Count SPAF<10
Total PCBs									
Uncalibrated	6.1	16 of 32	28 of 32	3.8	27 of 32	31 of 32	10.5	9 of 32	22 of 32
Post-calibration[a]	3.9	24 of 32	30 of 32	2.6	31 of 32	31 of 32	6.7	20 of 32	26 of 32
PCB 17									
Uncalibrated	7.7	18 of 32	27 of 32	3.1	28 of 32	30 of 32	16.1	14 of 32	20 of 32
Post-calibration[a]	5.9	23 of 32	28 of 32	2.6	29 of 32	32 of 32	12.2	18 of 32	22 of 32
PCB 118									
Uncalibrated	18.0	8 of 32	19 of 32	5.1	21 of 32	27 of 32	40.2	6 of 32	11 of 32
Post-calibration[a]	11.6	14 of 32	22 of 32	3.4	26 of 32	28 of 32	25.9	8 of 32	20 of 32
PCB 167									
Uncalibrated	3.6	26 of 32	31 of 32	2.5	30 of 32	31 of 32	6.5	19 of 32	30 of 32
Post-calibration[a]	2.4	31 of 32	31 of 32	2.4	28 of 32	30 of 32	4.1	25 of 32	30 of 32
4,4′-DDE									
Uncalibrated	3.6	27 of 32	31 of 32	2.6	30 of 32	32 of 32	5.0	22 of 32	29 of 32
Post-calibration[a]	2.6	30 of 32	32 of 32	2.0	32 of 32	32 of 32	3.4	25 of 32	31 of 32
DDx									
Uncalibrated	15.2	3 of 32	17 of 32	7.4	12 of 32	26 of 32	25.8	2 of 32	14 of 32
Post-calibration[a]	10.4	10 of 32	22 of 32	5.3	19 of 32	29 of 32	17.3	8 of 32	17 of 32

a Calibrated values were used for non-chemical-specific parameters. Nominal values were used for the chemical-specific parameters except for the chemical concentration in sediment.

Table B1-19

Calibrated Values for Environmental Parameters

Portland Harbor Superfund Site

Portland, Oregon

Model Component	Unit	Initial Distribution[a]	Calibrated Value
Water temperature	°C	13.9 (SD = 1.7)	13.7
Concentration of TSS	kg/L	1.13×10^{-5} (SD = 4.5×10^{-6})	1.4×10^{-5}
DOC concentration in water	kg/L	1.38×10^{-6} (SD = 5.9×10^{-8})	1.31×10^{-6}
Organic carbon content of sediment	Fraction	0.0171 (SD = 0.00028)	0.0171

[a] A normal distribution was assigned with the first value as the mean and the indicated standard deviation.

Table B1-20

Calibrated Values for General Biological Parameters

Portland Harbor Superfund Site

Portland, Oregon

Model Component	Model Symbol	Nominal Value (unitless)[a]
Resistance to chemical uptake through aqueous phase for phytoplankton/algae	UA	6.0×10^{-5}
Resistance to chemical uptake through organic phase for phytoplankton/algae	UB	5.5
Dietary transfer efficiency constant A	EDA	3.0×10^{-7}
Dietary transfer efficiency constant B	EDB	2.0
NLOM-octanol proportionality constant	BETA	0.035
NLOC-octanol proportionality constant	GAMMA	0.35

[a] No distributions were defined for these parameters.

Table B1-21
Calibrated Values for Species-Specific Biological Parameters
Portland Harbor Superfund Site
Portland, Oregon

Model Component	Unit	Distribution Type	Initial Distribution	Calibrated Value
Phytoplankton/algae				
Lipid content	Fraction	Triangle	0.00123 (0.0008 – 0.002)	0.00123
Moisture content	Fraction	Triangle	0.955 (0.935 – 0.993)	0.947
Fraction of porewater ventilated	Fraction	Point estimate	0	0
Growth rate constant	1/day	Triangle	0.08 (0.03 – 0.13)	0.09
Zooplankton				
Weight	kg	Triangle	1.4×10^{-7} (3.3×10^{-8} – 2.3×10^{-7})	1.7×10^{-7}
Lipid content	Fraction	Triangle	0.01 (0.009 – 0.011)	0.01
Moisture content	Fraction	Triangle	0.90 (0.80 – 0.98)	0.82
Dietary absorption efficiency of lipid	Fraction	Point estimate	0.72	0.72
Dietary absorption efficiency of NLOM	Fraction	Point estimate	0.72	0.72
Dietary absorption efficiency of water	Fraction	Point estimate	0.25	0.25
Fraction of porewater ventilated	Unitless	Point estimate	0	0
Benthic Invertebrate Filter Feeders (clams)				
Weight	kg	Normal	0.00125 (SD = 1.3×10^{-5})	0.00126
Lipid content	Fraction	Normal	0.022 (SD = 0.0011)	0.02225
Moisture content	Fraction	Normal	0.86 (SD = 0.0029)	0.863
Dietary absorption efficiency of lipid	Fraction	Point estimate	0.75	0.75
Dietary absorption efficiency of NLOM	Fraction	Point estimate	0.75	0.75
Dietary absorption efficiency of water	Fraction	Point estimate	0.25	0.25
Fraction of porewater ventilated	Unitless	Uniform	0.05 (0.01 – 0.10)	0.05
Filter feeder scavenging efficiency	Unitless	Point estimate	1.0	1.0
Benthic Invertebrate Consumers				

Table B1-21
Calibrated Values for Species-Specific Biological Parameters
Portland Harbor Superfund Site
Portland, Oregon

Model Component	Unit	Distribution Type	Initial Distribution	Calibrated Value
Weight	kg	Triangle	5.33×10^{-6} ($1.4 \times 10^{-6} – 6.0 \times 10^{-6}$)	4.80×10^{-6}
Lipid content	Fraction	Triangle	0.015 (0.008 – 0.042)	0.014
Moisture content	Fraction	Triangle	0.80 (0.72 – 0.88)	0.80
Dietary absorption efficiency of lipid	Fraction	Point estimate	0.75	0.75
Dietary absorption efficiency of NLOM	Fraction	Point estimate	0.75	0.75
Dietary absorption efficiency of water	Fraction	Point estimate	0.25	0.25
Fraction of porewater ventilated	Unitless	Uniform	0.01 – 0.10	0.07
Epibenthic Invertebrate Consumers (crayfish)				
Weight	kg	Normal	0.0435 (SD = 0.00071)	0.044
Lipid content	Fraction	Normal	0.0078 (SD = 0.00045)	0.0076
Moisture content	Fraction	Normal	0.74 (SD = 0.0031)	0.74
Dietary absorption efficiency of lipid	Fraction	Point estimate	0.75	0.75
Dietary absorption efficiency of NLOM	Fraction	Point estimate	0.75	0.75
Dietary absorption efficiency of water	Fraction	Point estimate	0.25	0.25
Fraction of porewater ventilated	Unitless	Uniform	0.01 – 0.10	0.03
Sculpin				
Weight	kg	Normal	0.0196 (SD = 0.00039)	0.02
Lipid content	Fraction	Normal	0.041 (SD = 0.0016)	0.042
Moisture content	Fraction	Normal	0.75 (SD = 0.0023)	0.75
Dietary absorption efficiency of lipid	Fraction	Point estimate	0.92	0.92
Dietary absorption efficiency of NLOM	Fraction	Point estimate	0.60	0.60
Dietary absorption efficiency of water	Fraction	Point estimate	0.25	0.25
Fraction of porewater ventilated	Fraction	Uniform	0.01 – 0.10	0.04
Largescale Sucker				
Weight	kg	Normal	0.794 (SD = 0.012)	0.8

Table B1-21
Calibrated Values for Species-Specific Biological Parameters
Portland Harbor Superfund Site
Portland, Oregon

Model Component	Unit	Distribution Type	Initial Distribution	Calibrated Value
Lipid content	Fraction	Normal	0.076 (SD = 0.0052)	0.07
Moisture content	Fraction	Normal	0.71 (SD = 0.0054)	0.7
Dietary absorption efficiency of lipid	Fraction	Point estimate	0.92	0.92
Dietary absorption efficiency of NLOM	Fraction	Point estimate	0.60	0.60
Dietary absorption efficiency of water	Fraction	Point estimate	0.25	0.25
Fraction of porewater ventilated	Unitless	Point estimate	0	0
Common Carp				
Weight	kg	Normal	2.48 (SD = 0.066)	2.50
Lipid content	Fraction	Normal	0.088 (SD = 0.0053)	0.09
Moisture content	Fraction	Normal	0.69 (SD = 0.0047)	0.07
Dietary absorption efficiency of lipid	Fraction	Point estimate	0.92	0.92
Dietary absorption efficiency of NLOM	Fraction	Point estimate	0.60	0.60
Dietary absorption efficiency of water	Fraction	Point estimate	0.25	0.25
Fraction of porewater ventilated	Unitless	Point estimate	0	0
Smallmouth Bass				
Weight	kg	Normal	0.395 (SD = 0.18)	0.35
Lipid content	Fraction	Normal	0.054 (SD = 0.0021)	0.051
Moisture content	Fraction	Normal	0.71 (SD = 0.0033)	0.71
Dietary absorption efficiency of lipid	Fraction	Point estimate	0.92	0.92
Dietary absorption efficiency of NLOM	Fraction	Point estimate	0.60	0.60
Dietary absorption efficiency of water	Fraction	Point estimate	0.25	0.25
Fraction of porewater ventilated	Unitless	Point estimate	0	0

Table B1-21
Calibrated Values for Species-Specific Biological Parameters
Portland Harbor Superfund Site
Portland, Oregon

Model Component	Unit	Distribution Type	Initial Distribution	Calibrated Value
Northern Pikeminnow				
Weight	kg	Normal	0.558 (SD = 0.048)	0.599
Lipid content	Fraction	Normal	0.053 (SD = 0.008)	0.063
Moisture content	Fraction	Normal	0.719 (SD = 0.0088)	0.713
Dietary absorption efficiency of lipid	Fraction	Point estimate	0.92	0.92
Dietary absorption efficiency of NLOM	Fraction	Point estimate	0.60	0.60
Dietary absorption efficiency of water	Fraction	Point estimate	0.25	0.25
Fraction of porewater ventilated	Fraction	Point estimate	0	0

Table B1-22
Calibrated Values for Species-Specific Dietary Parameters
Portland Harbor Superfund Site
Portland, Oregon

Species	Prey Item	Initial Distribution (%)[a]	Calibrated Value (%)
Zooplankton	Phytoplankton/algae	100	100
Benthic invertebrate filter feeders (clams)	Sediment solids	70 (50 – 80)	78
	Phytoplankton/algae	30 (20 – 50)	22
Benthic invertebrate consumers	Sediment solids	95 (85 – 100)	91
	Phytoplankton/algae	5 (0 – 15)	9
Epibenthic invertebrate consumers (crayfish)	Sediment solids	2 (0 – 4)	2
	Phytoplankton/algae	10 (0 – 20)	11
	Zooplankton	10 (0 – 20)	18
	Benthic invertebrates (filter feeders)	18 (0 – 35)	22
	Benthic invertebrates (consumers)	60 (25 – 75)	47
Sculpin	Sediment solids	0 (0 – 5)	3
	Zooplankton	0 (0 – 5)	3
	Benthic invertebrates (filter feeders)	15 (0 – 50)	32
	Benthic invertebrates (consumers)	80 (25 – 90)	53
	Epibenthic invertebrates (consumers)	5 (0 – 10)	9
Largescale sucker	Sediment solids	5 (1 – 15)	15
	Phytoplankton/algae	25 (0 – 60)	15
	Zooplankton	15 (5 – 25)	20
	Benthic invertebrates (filter feeders)	10 (5 – 15)	7
	Benthic invertebrates (consumers)	25 (15 – 35)	27
	Epibenthic invertebrates (consumers)	20 (0 – 40)	16
Common carp	Sediment solids	5 (0 – 10)	4
	Phytoplankton/algae	45 (30 – 60)	33
	Benthic invertebrates (filter feeders)	10 (5 – 15)	14
	Benthic invertebrates (consumers)	40 (25 – 55)	48
Smallmouth bass	Sediment solids	0	0
	Benthic invertebrates (consumers)	5 (0 – 30)	24
	Epibenthic invertebrates (consumers)	5 (0 – 30)	17
	Sculpin	90 (50 – 100)	59
Northern pikeminnow	Sediment solids	0	0
	Phytoplankton/algae	4 (0 – 10)	8
	Benthic invertebrates (filter feeders)	5 (0 – 10)	6
	Benthic invertebrates (consumers)	26 (15 – 45)	35
	Epibenthic invertebrates (consumers)	40 (25 – 65)	30
	Sculpin	25 (0 – 60)	21

[a] For all values in which a range is provided, a uniform distribution was assigned with the first number as the nominal value and the minimum and maximum defined by the range.

Table B1-23
Chemical-Specific K_{OW} and Water Concentration
Portland Harbor Superfund Site
Portland, Oregon

Chemical	K_{OW}		Water Concentration (ng/L)	
	Initial Distribution[a]	Calibrated Value	Initial Distribution[b]	Calibrated Value
Total PCBs	6.09 – 7.84	6.14	0.22 (SD = 0.0244)	0.23
PCB 77	5.62 – 7.87	6.02	0.00026 (SD = 0.000039)	0.00026
PCB 126	6.38 – 7.00	6.38	0.000013 (SD = 0.000001)	0.000012
4,4′-DDD	4.82 – 6.33	5.83	0.049 (SD = 0.0090)	0.053
4,4′-DDE	4.28 – 6.97	6.42	0.031 (SD = 0.0028)	0.031
4,4′-DDT	3.98 – 8.31	6.31	0.017 (SD = 0.0021)	0.015
Aldrin	3.01 – 7.50	4.11	0.0022 (SD = 0.00022)	0.0023
α-HCH	3.19 – 4.57	4.08	0.027 (SD = 0.0040)	0.017
β-HCH	3.19 – 4.26	3.43	0.0052 (SD = 0.00042)	0.0053
Dieldrin	2.60 – 6.20	5.26	0.067 (SD = 0.0092)	0.076
γ-HCH	3.19 – 4.26	3.69	0.025 (SD = 0.0013)	0.028
Heptachlor	3.87 – 6.10	4.04	0.00021 (SD = 0.000016)	0.00019
Heptachlor epoxide	3.65 – 5.42	4.74	0.0071 (SD = 0.00044)	0.0072
Sum DDD	4.80 – 6.31	5.73	0.070 (SD = 0.013)	0.094
Sum DDE	4.22 – 6.87	6.45	0.032 (SD = 0.0029)	0.038
Sum DDT	3.98 – 8.19	6.00	0.022 (SD = 0.0024)	0.022
Total chlordane	2.78 – 6.42	5.63	0.029 (SD = 0.0019)	0.031
DDx	4.34 – 7.08	5.91	0.13 (SD = 0.017)	0.14
1,2,3,7,8-PentaCDD	6.49 – 7.56	7.06	4.3×10^{-6} (2.9×10^{-6})[c]	4.3×10^{-6}
2,3,7,8-TetraCDD	5.38 – 8.93	6.38	2.7×10^{-6} (1.2×10^{-6})[c]	2.7×10^{-6}
1,2,3,4,7,8-HexaCDF	6.92 – 7.92	7.66	5.9×10^{-6} (1.7×10^{-6})[c]	5.9×10^{-6}
2,3,4,7,8-PentaCDF	6.56 – 7.82	6.95	3.5×10^{-6} (1.2×10^{-6})[c]	3.5×10^{-6}
2,3,7,8-TetraCDF	5.82 – 7.70	6.30	5.5×10^{-6} (1.2×10^{-6})[c]	5.5×10^{-6}

[a] Uniform distributions developed from literature K_{OW} values were used to calibrate the model

[b] Normal distributions based on XAD water samples from the lower Willamette River were used to calibrate the model and expressed as the mean plus standard deviation.

[c] Data for dioxins/furans is expressed as the mean plus the standard error.

Table B1-24
Chemical-Specific Metabolic Rate Constants for Significantly Metabolized Chemicals
Portland Harbor Superfund Site
Portland, Oregon

	Fish K_M (1/day)[a]			Invertebrate K_M (1/day)[b]		
Chemical	**Nominal Value**	**Initial Distribution**	**Calibrated Value**	**Nominal Value**	**Initial Distribution**	**Calibrated Value**
PCB 77	0.03	0 – 0.3	0.0070	NA	NA	NA
PCB 126	0.003	0 – 0.03	0.0064	NA	NA	NA
4,4′-DDT	0.01	0 – 0.1	0.010	0.01	0 – 0.1	0.058
Sum DDT	0.005	0 – 0.05	0.0078	NA	NA	NA
1,2,3,7,8-PentaCDD	0.019	0.005 – 0.07	0.008	0.019	0.005 – 0.07	0.008
2,3,7,8-TetraCDD	0.013	0.002 – 0.08	0.007	0.013	0.002 – 0.08	0.007
1,2,3,4,7,8-HexaCDF	0.06	0 – 0.6	0.015	0.06	0 – 0.6	0.015
2,3,4,7,8-PentaCDF	0.058	0.009 – 0.3	0.02	0.058	0.009 – 0.3	0.05
2,3,7,8-TetraCDF	0.12	0.01 – 0.5	0.03	0.12	0.01 – 0.5	0.03

[a] The fish metabolic rate was applied equally to all modeled fish species (sculpin, largescale sucker, carp,smallmouth bass, and northern pikeminnow).

[b] The metabolic rate for 4,4′-DDT was applied only to epibenthic invertebrate consumers.

Table B1-25
Calibrated Model Performance
Portland Harbor Superfund Site
Portland, Oregon

Chemical	SPAF						
	Benthic Invertebrate Filter Feeder	**Epibenthic Invertebrate Consumer**	**Sculpin**	**Largescale Sucker**	**Carp**	**Smallmouth Bass**	**Northern Pikeminnow**
Total PCBs	4.5	**1.3**	2.0	1.4	3.7	**1.3**	**1.2**
PCB 77	2.3	1.1	**1.1**	ND	1.2	**1.1**	ND
PCB 126	1.1	**2.9**	**1.3**	ND	2.8	**1.4**	ND
4,4′-DDD	q	**(2.9)**	1.4	2.0	1.6	**(1.1)**	**(1.2)**
4,4′-DDE	4.7	**(1.4)**	1.6	2.5	2.4	**(1.2)**	2.7
4,4′-DDT	**(1.5)**	**(2.2)**	2.7	4.4	**(4.2)**	**(1.1)**	**(1.9)**
Aldrin	3.5	NE	6.0	NE	2.4[b]	**(1.5)**[b]	NE
α-HCH	**(1.2)**	NE	**(8.1)**[b]	NE	**(1.3)**[b]	**(1.1)**[b]	NE
β-HCH	NE	NE	4.0[b]	NE	**(1.5)**[b]	**(1.2)**[b]	NE
Dieldrin	1.7	NE	3.9	NE	**(1.1)**	**(1.0)**[b]	NE
γ-HCH	**(1.8)**	NE	3.2[b]	NE	**(1.3)**[b]	**(1.2)**[b]	NE
Heptachlor	1.2	NE	NE	NE	NE	**(1.2)**[b]	NE
Heptachlor epoxide	2.9	NE	3.6[b]	NE	**(1.1)**[b]	1.0[b]	NE
Sum DDD	5.8	**(3.1)**	1.4	2.0	1.8	**(1.0)**	**(1.1)**
Sum DDE	3.9	**(1.6)**	1.3	1.9	1.9	**(1.4)**	2.1
Sum DDT	1.0	**(3.1)**	3.4	3.8	**(2.7)**	**(1.1)**	**(1.0)**
Total chlordane	3.8	1.7[b]	2.4	NE	1.3	**(1.1)**	NE
DDx	3.4	**(1.7)**	2.1	1.9	1.2	**(1.2)**	1.6
1,2,3,7,8-PentaCDD	**1.1**	**2.7**	**2.0**	ND	2.5	1.0	ND
2,3,7,8-TetraCDD	1.6	**1.4**	**1.7**	ND	2.5	1.2	ND
1,2,3,4,7,8-HexaCDF	**1.2**	1.3	1.8	ND	1.7	1.0	ND
2,3,4,7,8-PentaCDF	**1.8**	**1.3**	**3.5**	ND	**1.5**	**1.1**	ND
2,3,7,8-TetraCDF	**1.4**	1.2	**1.1**	ND	**1.5**	**1.1**	ND

[a] **SPAFs** shown in bold and in parentheses indicate that the model was over-predicting for this species-chemical combination.

[b] When high Round 1 reporting limits for non-detected chemical concentrations caused poor model performance, model results were compared to empirical data summarized without these non-detect data.

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Table B1-26
Water Contribution to Model-Predicted Tissue Concentrations
Portland Harbor Superfund Site
Portland, Oregon

	Model Input Values			Percent Contribution from Water Pathway							
Chemical	**Sediment (µg/kg dw)**	**Water (ng/L)**	K_{OW}	**Benthic Invertebrate Filter Feeder**	**Benthic Invertebrate Consumer**	**Epibenthic Invertebrate Consumer**	**Sculpin**	**Large-scale Sucker**	**Carp**	**Smallmouth Bass**	**Northern Pike-minnow**
Total PCBs	92.6	0.228	6.14	13	7	12	10	11	11	10	11
PCB 77	0.18	0.0003	6.02	7	4	7	6	6	6	6	6
PCB 126	0.018	0.00001	6.38	5	2	4	4	4	4	4	4
4,4′-DDD	6.26	0.053	5.83	26	16	27	23	24	25	24	25
4,4′-DDE	3.43	0.031	6.42	40	24	37	32	36	34	33	33
4,4′-DDT	14.8	0.015	6.31	7	3	6	5	5	5	5	5
Aldrin	0.47	0.0023	4.11	0.7	0.5	1.3	0.8	6	7	6	8
α-HCH	0.27	0.017	4.08	8	6	13	9	47	48	47	53
β-HCH	1.28	0.0053	3.43	0.1	0.09	0.2	0.1	5	5	5	6
Dieldrin	0.54	0.076	5.26	70	60	77	71	76	78	77	79
γ-HCH	0.71	0.028	3.69	2	2	4	2	34	35	35	41
Heptachlor	0.22	0.00019	4.04	0.1	0.08	0.2	0.1	1.2	1.2	1.2	1.5
Heptachlor epoxide	0.29	0.0072	4.74	12	9	19	14	28	30	30	34
Sum DDD	8.89	0.094	5.73	27	17	30	25	27	28	27	28
Sum DDE	4.22	0.038	6.45	41	24	37	33	37	34	33	33
Sum DDT	17.3	0.022	6.00	6	3	6	5	5	5	5	5
Total chlordane	2.40	0.031	5.63	28	19	32	27	28	31	29	31
DDx	30.3	0.14	5.91	17	10	18	15	16	16	15	16
1,2,3,7,8-PentaCDD	0.00025	0.000004	6.7	61	40	56	49	57	52	50	51
2,3,7,8-TetraCDD	0.0001	0.000003	6.3	65	46	62	56	61	59	57	58
1,2,3,4,7,8-HexaCDF	0.0027	0.000006	7.0	18	9	16	12	17	13	12	13
2,3,4,7,8-PentaCDF	0.012	0.000004	6.6	3	1	3	2	2	2	2	2
2,3,7,8-TetraCDF	0.017	0.000006	6.3	2	1	2	2	2	2	2	2

Table B1-27

Comparison of Empirical and Mechanistic Model-Predicted Tissue Concentrations for Species Not Directly Modeled

Portland Harbor Superfund Site

Portland, Oregon

	Brown Bullhead				**Black Crappie**				**Peamouth**			
		Tissue Concentration (µg/kg ww)				**Tissue Concentration (µg/kg ww)**				**Tissue Concentration (µg/kg ww)**		
Chemical	**DF**	**Empirical**	**Model-Predicted[a]**	**SPAF**	**DF**	**Empirical**	**Model-Predicted[a]**	**SPAF**	**DF**	**Empirical**	**Model-Predicted[a]**	**SPAF**
PCB 77	6/6	0.047	0.23	**4.9**	4/4	0.30	0.30			ND	NA	NA
PCB 126	6/6	0.027	0.031	**1.1**	4/4	0.017	0.046	**2.6**	ND	ND	NA	NA
Total PCBs	6/6	511	610	**1.2**	4/4	164	350	**2.1**	4/4	190	350	**1.8**
4,4′-DDD	6/6	9.4	28	**2.9**	4/4	12	14	**1.2**	4/4	23	14	1.6
4,4′-DDE	6/6	47	48	**1.0**	4/4	56	28	2.0	4/4	130	28	4.6
4,4′-DDT	5/6	20	13	1.5	3/4	9.2	26	**2.8**	2/4	4.9	26	**5.3**
Aldrin	0/6	1.8	--	--	0/4	0.54	--	--	0/4	0.61	--	--
α-HCH	0/6	1.2	--	--	1/4	0.73	--	--	0/4	0.5	--	--
β-HCH	0/6	1.9	--	--	0/4	1.1	--	--	0/4	1.6	--	--
Dieldrin	2/6	2.5	--	--	1/4	2.8	--	--	0/4	1.1	--	--
γ-HCH	3/6	2	--	--	0/4	0.64	--	--	0/4	1.1	--	--
Heptachlor	0/6	1.8	--	--	1/4	0.86	--	--	0/4	0.84	--	--
Heptachlor epoxide	0/6	1.3	--	--	0/4	0.5	--	--	0/4	0.5	--	--
Sum DDD	6/6	13	33	**2.5**	4/4	14	17	**1.2**	4/4	25	17	1.4
Sum DDE	6/6	49	62	**1.3**	4/4	57	37	1.5	4/4	140	37	3.8
Sum DDT	5/6	27	19	1.4	3/4	13	26	2.0	2/4	7.2	26	3.6
Total chlordane	4/6	19	7.5	2.5	4/4	11	4.0	2.8	2/4	9	4.0	SD2.3
DDx	6/6	88	140	1.6	4/4	84	74	1.1	4/4	170	74	2.3

[a] Model predictions for brown bullhead were for benthivorous fish (as represented by largescale sucker in the model). Model predictions for black crappie and peamouth were for foraging fish (as represented by sculpin in the model).

[a] **SPAFs** shown in **bold** indicate that the model was over-predicting for this species-chemical combination.

-- Insufficient data for evaluation

Table B1-28

Comparison of Empirical and Model-Predicted Tissue Concentrations for Dioxins and Furans for Species Not Directly Modeled

Portland Harbor Superfund Site

Portland, Oregon

	Sculpin				Black Crappie			
		Tissue Concentration (µg/kg ww)				Tissue Concentration (µg/kg ww)		
Chemical	**DF**	**Empirical**	**Model-Predicted[a]**	**SPAF**	**DF**	**Empirical**	**Model-Predicted[a]**	**SPAF**
1,2,3,7,8-PentaCDD	21/21	0.00050	0.0010	+ 2.0	4/4	0.00047	0.0010	+ 2.2
2,3,7,8-TetraCDD	21/21	0.00026	0.00044	+ 1.7	4/4	0.00033	0.00044	+ 1.3
1,2,3,4,7,8-HexaCDF	21/21	0.0044	0.0024	- 1.8	4/4	0.00016	0.0024	+ 15
2,3,4,7,8-PentaCDF	21/21	0.0021	0.0074	+ 3.5	4/4	0.00028	0.0074	+ 27
2,3,7,8-TetraCDF	21/21	0.0087	0.0096	+ 1.1	4/4	0.0014	0.0096	+ 7.0

[a] Model predictions for brown bullhead were for benthivorous fish (as represented by largescale sucker in the mechanistic model). Model predictions for black crappie were for foraging fish (as represented by sculpin in the mechanistic model). No peamouth data were available for dioxins and furans.

Table B2-1
Dioxin/Furan Congener Analysis in Smallmouth Bass Tissue
Portland Harbor Superfund Site
Portland, Oregon

SMB Location	RiverMile	Analyte	Concentration in SMB (pg/g)	TEFs-WHO Mammalian TEF	Dietary TEC Predicted Concentration (pg/g)	Percent Contribution to Risk (%)
SB02E	1.5 - 2.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.054	0.01	0.00054	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.070	0.01	0.00070	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.017	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.084	0.1	0.00844	1
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.082	0.1	0.00824	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.047	0.1	0.00467	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.362	0.1	0.03620	3
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.008	0.1	0.00078	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.049	0.1	0.00489	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.260	0.03	0.00780	1
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.469	1	0.46900	34
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.039	0.1	0.00387	0
		2,3,4,7,8-Pentachlorodibenzofuran	0.578	0.3	0.17340	13
		2,3,7,8-Tetrachlorodibenzofuran	3.540	0.1	0.35400	26
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.313	1	0.31300	23
		Sum PCDD and PCDF			1.38552	100
SB03E	2.5 - 3.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.071	0.01	0.00071	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.105	0.01	0.00105	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.023	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.099	0.1	0.00985	1
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.092	0.1	0.00924	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.042	0.1	0.00418	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.485	0.1	0.04850	4
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.007	0.1	0.00072	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.046	0.1	0.00461	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.221	0.03	0.00663	1
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.481	1	0.48100	38
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.033	0.1	0.00329	0
		2,3,4,7,8-Pentachlorodibenzofuran	0.580	0.3	0.17400	14
		2,3,7,8-Tetrachlorodibenzofuran	1.860	0.1	0.18600	15
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.337	1	0.33700	27
		Sum PCDD and PCDF			1.26679	100
SB03W	2.5 - 3.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.057	0.01	0.00057	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.304	0.01	0.00304	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.021	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.225	0.1	0.02250	1
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.114	0.1	0.01140	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.071	0.1	0.00709	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.742	0.1	0.07420	5
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.008	0.1	0.00081	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.062	0.1	0.00621	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.400	0.03	0.01200	1
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.622	1	0.62200	40
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.049	0.1	0.00486	0
		2,3,4,7,8-Pentachlorodibenzofuran	0.770	0.3	0.23100	15
		2,3,7,8-Tetrachlorodibenzofuran	2.000	0.1	0.20000	13
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.375	1	0.37500	24
		Sum PCDD and PCDF			1.57069	100
SB04E	3.5 - 4.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.136	0.01	0.00136	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.736	0.01	0.00736	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.020	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.459	0.1	0.04590	2
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.120	0.1	0.01200	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.130	0.1	0.01300	1
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.752	0.1	0.07520	4
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.010	0.1	0.00096	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.074	0.1	0.00743	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.556	0.03	0.01668	1
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.742	1	0.74200	37
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.085	0.1	0.00852	0
		2,3,4,7,8-Pentachlorodibenzofuran	1.300	0.3	0.39000	20
		2,3,7,8-Tetrachlorodibenzofuran	2.570	0.1	0.25700	13
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.420	1	0.42000	21
		Sum PCDD and PCDF			1.99741	100

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Dioxin/Furan Congener Analysis in Smallmouth Bass Tissue
Portland Harbor Superfund Site
Portland, Oregon

SMB Location	RiverMile	Analyte	Concentration in SMB (pg/g)	TEFs-WHO Mammalian TEF	Dietary TEC Predicted Concentration (pg/g)	Percent Contribution to Risk (%)
SB04W	3.5 - 4.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.052	0.01	0.00052	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.089	0.01	0.00089	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.017	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.132	0.1	0.01320	1
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.089	0.1	0.00893	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.053	0.1	0.00532	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.434	0.1	0.04340	3
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.010	0.1	0.00102	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.020	0.1	0.00202	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.420	0.03	0.01260	1
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.594	1	0.59400	37
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.037	0.1	0.00370	0
		2,3,4,7,8-Pentachlorodibenzofuran	0.738	0.3	0.22140	14
		2,3,7,8-Tetrachlorodibenzofuran	2.400	0.1	0.24000	15
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.462	1	0.46200	29
		Sum PCDD and PCDF			1.60900	100
SB05W	4.5 - 5.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.041	0.01	0.00041	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.175	0.01	0.00175	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.016	0.0003	0.00000	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.184	0.1	0.01840	1
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.116	0.1	0.01160	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.064	0.1	0.00637	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.636	0.1	0.06360	4
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.009	0.1	0.00086	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.042	0.1	0.00420	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.535	0.03	0.01605	1
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.648	1	0.64800	38
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.038	0.1	0.00379	0
		2,3,4,7,8-Pentachlorodibenzofuran	0.775	0.3	0.23250	14
		2,3,7,8-Tetrachlorodibenzofuran	2.680	0.1	0.26800	16
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.408	1	0.40800	24
		Sum PCDD and PCDF			1.68353	100
SB06E	5.5 - 6.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.178	0.01	0.00178	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.275	0.01	0.00275	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.021	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.182	0.1	0.01820	1
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.087	0.1	0.00867	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.163	0.1	0.01630	1
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.562	0.1	0.05620	4
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.009	0.1	0.00088	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.056	0.1	0.00561	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.397	0.03	0.01191	1
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.581	1	0.58100	39
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.042	0.1	0.00418	0
		2,3,4,7,8-Pentachlorodibenzofuran	0.727	0.3	0.21810	15
		2,3,7,8-Tetrachlorodibenzofuran	1.900	0.1	0.19000	13
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.358	1	0.35800	24
		Sum PCDD and PCDF			1.47359	100
SB06W	5.5 - 6.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.042	0.01	0.00042	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.146	0.01	0.00146	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.016	0.0003	0.00000	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.515	0.1	0.05150	2
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.070	0.1	0.00695	0
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.121	0.1	0.01210	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.459	0.1	0.04590	2
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.012	0.1	0.00119	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.024	0.1	0.00243	0
		1,2,3,7,8-Pentachlorodibenzofuran	2.380	0.03	0.07140	3
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.580	1	0.58000	21
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.043	0.1	0.00425	0
		2,3,4,7,8-Pentachlorodibenzofuran	3.210	0.3	0.96300	36
		2,3,7,8-Tetrachlorodibenzofuran	5.200	0.1	0.52000	19
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.452	1	0.45200	17
		Sum PCDD and PCDF			2.71260	100

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Portland Harbor Superfund Site
Portland, Oregon

SMB Location	RiverMile	Analyte	Concentration in SMB (pg/g)	TEFs-WHO Mammalian TEF	Dietary TEC Predicted Concentration (pg/g)	Percent Contribution to Risk (%)
SB07E	6.5 - 7.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.083	0.01	0.00083	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.281	0.01	0.00281	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.026	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.404	0.1	0.04040	0
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.634	0.1	0.06340	0
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.197	0.1	0.01970	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	4.850	0.1	0.48500	3
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.012	0.1	0.00115	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.665	0.1	0.06650	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.650	0.03	0.01950	0
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	12.800	1	12.80000	81
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.181	0.1	0.01810	0
		2,3,4,7,8-Pentachlorodibenzofuran	2.200	0.3	0.66000	4
		2,3,7,8-Tetrachlorodibenzofuran	1.750	0.1	0.17500	1
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	1.370	1	1.37000	9
		Sum PCDD and PCDF			15.72240	100
SB07W	6.5 - 7.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.395	0.01	0.00395	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.303	0.01	0.00303	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.193	0.0003	0.00006	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	39.500	0.1	3.95000	8
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.100	0.1	0.00996	0
		1,2,3,6,7,8-Hexachlorodibenzofuran	7.460	0.1	0.74600	1
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.592	0.1	0.05920	0
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.292	0.1	0.02920	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.053	0.1	0.00530	0
		1,2,3,7,8-Pentachlorodibenzofuran	74.300	0.03	2.22900	4
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.687	1	0.68700	1
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.990	0.1	0.09900	0
		2,3,4,7,8-Pentachlorodibenzofuran	108.000	0.3	32.40000	62
		2,3,7,8-Tetrachlorodibenzofuran	110.000	0.1	11.00000	21
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.644	1	0.64400	1
		Sum PCDD and PCDF			51.86570	100
SB08E	7.5 - 8.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.074	0.01	0.00074	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.502	0.01	0.00502	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.021	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.407	0.1	0.04070	2
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.182	0.1	0.01820	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.147	0.1	0.01470	1
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.860	0.1	0.18600	7
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.016	0.1	0.00161	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.135	0.1	0.01350	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.907	0.03	0.02721	1
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1.180	1	1.18000	44
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.102	0.1	0.01020	0
		2,3,4,7,8-Pentachlorodibenzofuran	1.670	0.3	0.50100	18
		2,3,7,8-Tetrachlorodibenzofuran	1.940	0.1	0.19400	7
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.518	1	0.51800	19
		Sum PCDD and PCDF			2.71088	100
SB08W	7.5 - 8.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.099	0.01	0.00099	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.344	0.01	0.00344	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.027	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	1.800	0.1	0.18000	4
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.112	0.1	0.01120	0
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.374	0.1	0.03740	1
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.550	0.1	0.05500	1
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.025	0.1	0.00245	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.069	0.1	0.00692	0
		1,2,3,7,8-Pentachlorodibenzofuran	4.640	0.03	0.13920	3
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.700	1	0.70000	15
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.078	0.1	0.00779	0
		2,3,4,7,8-Pentachlorodibenzofuran	4.010	0.3	1.20300	27
		2,3,7,8-Tetrachlorodibenzofuran	17.300	0.1	1.73000	38
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.462	1	0.46200	10
		Sum PCDD and PCDF			4.53940	100

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SMB Location	RiverMile	Analyte	Concentration in SMB (pg/g)	TEFs-WHO Mammalian TEF	Dietary TEC Predicted Concentration (pg/g)	Percent Contribution to Risk (%)
SB09E	8.5 - 9.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.069	0.01	0.00069	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.289	0.01	0.00289	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.017	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.182	0.1	0.01820	1
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.180	0.1	0.01800	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.085	0.1	0.00846	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.904	0.1	0.09040	4
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.008	0.1	0.00081	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.101	0.1	0.01010	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.245	0.03	0.00735	0
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1.260	1	1.26000	55
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.069	0.1	0.00689	0
		2,3,4,7,8-Pentachlorodibenzofuran	0.896	0.3	0.26880	12
		2,3,7,8-Tetrachlorodibenzofuran	1.020	0.1	0.10200	4
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.513	1	0.51300	22
		Sum PCDD and PCDF			2.30760	100
SB09W	8.5 - 9.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.088	0.01	0.00088	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.930	0.01	0.00930	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.016	0.0003	0.00000	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.166	0.1	0.01660	1
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.174	0.1	0.01740	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.087	0.1	0.00869	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.931	0.1	0.09310	3
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.009	0.1	0.00086	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.095	0.1	0.00950	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.323	0.03	0.00969	0
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.958	1	0.95800	29
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.060	0.1	0.00602	0
		2,3,4,7,8-Pentachlorodibenzofuran	0.887	0.3	0.26610	8
		2,3,7,8-Tetrachlorodibenzofuran	1.640	0.1	0.16400	5
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	1.720	1	1.72000	52
		Sum PCDD and PCDF			3.28015	100
SB010E	9.5 - 10.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.040	0.01	0.00040	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.201	0.01	0.00201	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.013	0.0003	0.00000	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.153	0.1	0.01530	1
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.075	0.1	0.00752	0
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.072	0.1	0.00716	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.332	0.1	0.03320	2
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.010	0.1	0.00103	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.022	0.1	0.00217	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.183	0.03	0.00549	0
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.738	1	0.73800	47
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.028	0.1	0.00284	0
		2,3,4,7,8-Pentachlorodibenzofuran	0.570	0.3	0.17100	11
		2,3,7,8-Tetrachlorodibenzofuran	0.878	0.1	0.08780	6
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.481	1	0.48100	31
		Sum PCDD and PCDF			1.55492	100
SB010W	9.5 - 10.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.061	0.01	0.00061	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.350	0.01	0.00350	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.015	0.0003	0.00000	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.407	0.1	0.04070	1
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.172	0.1	0.01720	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.137	0.1	0.01370	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.849	0.1	0.08490	3
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.010	0.1	0.00103	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.106	0.1	0.01060	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.307	0.03	0.00921	0
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1.090	1	1.09000	33
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.074	0.1	0.00739	0
		2,3,4,7,8-Pentachlorodibenzofuran	4.580	0.3	1.37400	42
		2,3,7,8-Tetrachlorodibenzofuran	1.130	0.1	0.11300	3
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.510	1	0.51000	16
		Sum PCDD and PCDF			3.27584	100

Table B2-1
Dioxin/Furan Congener Analysis in Smallmouth Bass Tissue
Portland Harbor Superfund Site
Portland, Oregon

SMB Location	RiverMile	Analyte	Concentration in SMB (pg/g)	TEFs-WHO Mammalian TEF	Dietary TEC Predicted Concentration (pg/g)	Percent Contribution to Risk (%)
SB011E	10.5 - 11.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.332	0.01	0.00332	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.615	0.01	0.00615	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.0408	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.484	0.1	0.04840	2
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.333	0.1	0.03330	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.208	0.1	0.02080	1
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.21	0.1	0.12100	5
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.00887	0.1	0.00089	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.259	0.1	0.02590	1
		1,2,3,7,8-Pentachlorodibenzofuran	0.333	0.03	0.00999	0
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1.27	1	1.27000	54
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.149	0.1	0.01490	1
		2,3,4,7,8-Pentachlorodibenzofuran	0.889	0.3	0.26670	11
		2,3,7,8-Tetrachlorodibenzofuran	1.13	0.1	0.11300	5
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.415	1	0.41500	18
		Sum PCDD and PCDF			2.34936	100
SB011W	10.5 - 11.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.398	0.01	0.00398	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.336	0.01	0.00336	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.0638	0.0003	0.00002	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.484	0.1	0.04840	2
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.111	0.1	0.01110	0
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.195	0.1	0.01950	1
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.737	0.1	0.07370	3
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.127	0.1	0.01270	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.0645	0.1	0.00645	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.355	0.03	0.01065	0
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1.03	1	1.03000	38
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.127	0.1	0.01270	0
		2,3,4,7,8-Pentachlorodibenzofuran	2.62	0.3	0.78600	29
		2,3,7,8-Tetrachlorodibenzofuran	1	0.1	0.10000	4
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.607	1	0.60700	22
		Sum PCDD and PCDF			2.72556	100

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Table B2-2
Comparison of Dioxin/Furan Congener Analysis in Sediment and Smallmouth Bass Tissue (RM 1.5-2.5E)
Portland Harbor Superfund Site
Portland, Oregon

SMB Location	RiverMile	Analyte	Average Concentration in Sediment (pg/g)	WHO Mammalian TEF	Dietary TEC Predicted Concentration in Sediment (pg/g)	Percent Contribution to Risk (%)	Concentration in SMB (pg/g)	WHO Mammalian TEF	Dietary TEC Predicted Concentration in SMB (pg/g)	Percent Contribution to Risk (%)
SB02E	1.5 - 2.5	1,2,3,4,6,7,8-Heptachlorodibenzofuran	7.04	0.01	0.07	6	0.054	0.01	0.00054	0
		1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	24.36	0.01	0.24	22	0.070	0.01	0.00070	0
		1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.36	0.0003	0.00	0	0.017	0.0003	0.00001	0
		1,2,3,4,7,8-Hexachlorodibenzofuran	0.91	0.1	0.09	8	0.084	0.1	0.00844	1
		1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.20	0.1	0.02	2	0.082	0.1	0.00824	1
		1,2,3,6,7,8-Hexachlorodibenzofuran	0.46	0.1	0.05	4	0.047	0.1	0.00467	0
		1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	1.07	0.1	0.11	10	0.362	0.1	0.03620	3
		1,2,3,7,8,9-Hexachlorodibenzofuran	0.09	0.1	0.01	1	0.008	0.1	0.00078	0
		1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.57	0.1	0.06	5	0.049	0.1	0.00489	0
		1,2,3,7,8-Pentachlorodibenzofuran	0.38	0.03	0.01	1	0.260	0.03	0.00780	1
		1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.14	1	0.14	13	0.469	1	0.46900	34
		2,3,4,6,7,8-Hexachlorodibenzofuran	0.21	0.1	0.02	2	0.039	0.1	0.00387	0
		2,3,4,7,8-Pentachlorodibenzofuran	0.43	0.3	0.13	12	0.578	0.3	0.17340	13
		2,3,7,8-Tetrachlorodibenzofuran	0.64	0.1	0.06	6	3.540	0.1	0.35400	26
		2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.08	1	0.08	7	0.313	1	0.31300	23
		Sum PCDD and PCDF	36.94		1.09	100			1.38552	100

Table B2-3
Values Used to Compare Total PCDD/F in Sediment to TEQ in fish tissue
Portland Harbor Superfund Site
Portland, Oregon

LocationID	LocationName	RiverMile	Task	SampleDate	Species	Tissue	SampleID	ParentSample	SMB Concentration	Average Sediment Concentration	Units	Notes
LW3-SB02E-C00	SB02E	1.5 - 2.5	B01-01-67B_Biota	39329	smallmouth bass	whole body	LW3-SB02E-C00WB	LW3-SB02E-C00F / LW3-SB02E-C00B	1.39	44.08120667	pg/g	
LW3-SB03E-C00	SB03E	2.5 - 3.5	B01-01-67B_Biota	39329	smallmouth bass	whole body	LW3-SB03E-C00WB	LW3-SB03E-C00F / LW3-SB03E-C00B	1.26	82.13632	pg/g	
LW3-SB03W-C00	SB03W	2.5 - 3.5	B01-01-67B_Biota	39329	smallmouth bass	whole body	LW3-SB03W-C00WB	LW3-SB03W-C00F / LW3-SB03W-C00B	1.57	10.627875	pg/g	
LW3-SB04W-C00	SB04W	3.5 - 4.5	B01-01-67B_Biota	39329	smallmouth bass	whole body	LW3-SB04W-C00WB	LW3-SB04W-C00F / LW3-SB04W-C00B	1.61	43.6932	pg/g	
LW3-SB04E-C00	SB04E	3.5 - 4.5	B01-01-67B_Biota	39329	smallmouth bass	whole body	LW3-SB04E-C01WB	LW3-SB04E-C01F / LW3-SB04E-C01B	2	94.768375	pg/g	
LW3-SB05W-C00	SB05W	4.5 - 5.5	B01-01-67B_Biota	39330	smallmouth bass	whole body	LW3-SB05W-C00WB	LW3-SB05W-C00F / LW3-SB05W-C00B	1.68	103.656	pg/g	
LW3-SB06E-C00	SB06E	5.5 - 6.5	B01-01-67B_Biota	39330	smallmouth bass	whole body	LW3-SB06E-C00WB	LW3-SB06E-C00F / LW3-SB06E-C00B	1.47	140.7552857	pg/g	
LW3-SB06W-C00	SB06W	5.5 - 6.5	B01-01-67B_Biota	39330	smallmouth bass	whole body	LW3-SB06W-C00WB	LW3-SB06W-C00F / LW3-SB06W-C00B	2.71	72.502925	pg/g	
LW3-SB07W-C00	SB07W	6.5 - 7.5	B01-01-67B_Biota	39331	smallmouth bass	whole body	LW3-SB07W-C00WB	LW3-SB07W-C00F / LW3-SB07W-C00B	51.9	19473.51401	pg/g	
LW3-SB07E-C00	SB07E	6.5 - 7.5	B01-01-67B_Biota	39330	smallmouth bass	whole body	LW3-SB07E-C00WB	LW3-SB07E-C00F / LW3-SB07E-C00B	15.7	4459.650997	pg/g	
LW3-SB08W-C00	SB08W	7.5 - 8.5	B01-01-67B_Biota	39331	smallmouth bass	whole body	LW3-SB08W-C00WB	LW3-SB08W-C00F / LW3-SB08W-C00B	4.54	39.60333571	pg/g	
LW3-SB08E-C00	SB08E	7.5 - 8.5	B01-01-67B_Biota	39330	smallmouth bass	whole body	LW3-SB08E-C00WB	LW3-SB08E-C00F / LW3-SB08E-C00B	2.71	37.15718	pg/g	
LW3-SB09W-C00	SB09W	8.5 - 9.5	B01-01-67B_Biota	39322	smallmouth bass	whole body	LW3-SB09W-C00WB	LW3-SB09W-C00F / LW3-SB09W-C00B	3.28	139.0986	pg/g	
LW3-SB09E-C00	SB09E	8.5 - 9.5	B01-01-67B_Biota	39331	smallmouth bass	whole body	LW3-SB09E-C00WB	LW3-SB09E-C00F / LW3-SB09E-C00B	2.31	321.72025	pg/g	
LW3-SB010E-C00	SB010E	9.5 - 10.5	B01-01-67B_Biota	39331	smallmouth bass	whole body	LW3-SB010E-C00WB	LW3-SB010E-C00F / LW3-SB010E-C00B	1.55	37.1838	pg/g	
LW3-SB010W-C00	SB010W	9.5 - 10.5	B01-01-67B_Biota	39330	smallmouth bass	whole body	LW3-SB010W-C00WB	LW3-SB010W-C00F / LW3-SB010W-C00B	3.28	190.62315	pg/g	
LW3-SB011W-C00	SB011W	10.5 - 11.5	B01-01-67B_Biota	39332	smallmouth bass	whole body	LW3-SB011W-C00WB	LW3-SB011W-C00F / LW3-SB011W-C00B	2.72	9.932	pg/g	*no sed data available; used NC data
LW3-SB011E-C00	SB011E	10.5 - 11.5	B01-01-67B_Biota	39330	smallmouth bass	whole body	LW3-SB011E-C00WB	LW3-SB011E-C00F / LW3-SB011E-C00B	2.35	155.2552208	pg/g	

Table B2-4
Summary of Background Values for Dioxin/Furan Congeners
Portland Harbor Superfund Site
Portland, Oregon

		All Data						Outliers Removed						
			95% UPL		95% UCL				95% UPL		95% UCL			
Chemical	**Units**	**Distribution**	**Type**	**UPL**	**Type**	**UCL**	**No of Outliers Removed**	**Distribution**	**Type**	**UPL**	**Type**	**UCL**	**UCL-OC Equivalent**	**Notes**
1,2,3,4,7,8-HxCDF	µg/kg	Lognormal	ROS	0.0002	Km-t	0.0002	0						0.0004	
1,2,3,7,8-PeCDD	µg/kg	No background calculated – insufficient detections[a]				0.0001							0.0002	
2,3,4,7,8-PeCDF	µg/kg	No background calculated – insufficient detections[a]				0.0002							0.0003	
2,3,7,8-TCDD	µg/kg	No background calculated – insufficient detections[a]				0.0001							0.0002	
2,3,7,8-TCDF	µg/kg	No background calculated – insufficient detections[a]				0.0002							0.0003	

[a] Background calculated as the 95th percentile of the reported detection limits in the background data set

Table B3-1
Human Health Exposure Values
Portland Harbor Superfund Site
Portland, Oregon

Symbol	Description	Subsistence Fisher	Tribal Fisher	Recreational Beach Use	Dockside Worker	In-Water Worker	Infant Consumption of Breast milk
ABS_{dermal}	dermal absorption efficiency (unitless)	See Table 2	See Table 2	See Table 2	See Table 2	See Table 2	--
ABS_{oral}	absorption efficiency (mg-yr/kg-day)	See Table 2	See Table 2	See Table 2	See Table 2	See Table 2	--
AE	oral absorption efficiency (unitless)	--	--	--	--	--	1
AF_a	soil-to-skin adherence factor – adult (mg/cm^2)	0.3	0.3	0.3	0.2	0.2	--
AF_c	soil-to-skin adherence factor – child (mg/cm^2)	--	--	3.3	--	--	--
AT_{nc}	averaging time – noncarcinogenic effects (days)	ED × 365 d/yr	ED × 365 d/yr	ED × 365 d/yr	ED × 365 d/yr	ED × 365 d/yr	ED × 365 d/yr
AT_c	averaging time – carcinogenic effect (days)	25,550	25,550	25,550	25,550	25,550	--
AT_{inf}	averaging time – infant exposure (days)	--	--	--	--	--	365
BW_a	body weight – adult (kg)	70	--	70	70	70	70
BW_m	body weight – maternal body weight, kg	66	66	66	66	66	--
BW_c	body weight – child (kg)	15	--	15	--	--	--
BW_{inf}	average infant body weight (kg)	--	--	--	--	--	7.8
CR_a	consumption rate of fish/shellfish – adult (g/day, wet-weight)	142/3.3	--	--	--	--	142
CR_c	consumption rate of fish/shellfish – child (g/day, wet-weight)	60/--	--	--	--	--	--
CR_{milk}	infant consumption rate of breast milk (kg/day)	--	--	--	--	--	0.98
ED_{0-2}	exposure duration ages 0-2 (years)	--	--	2	--	--	--
ED_{16-30}	exposure duration ages 16-30 (years)	--	--	14	--	--	--
ED_{2-6}	exposure duration ages 2-6 (years)	--	--	4	--	--	--
ED_{6-16}	exposure duration ages 6-16 (years)	--	--	10	--	--	--
ED_a	exposure duration – adult (years)	30	70	30	25	10	--
ED_c	exposure duration – child (years)	6	--	6	--	--	--
ED_{inf}	exposure duration of breastfeeding infant (days)	--	--	--	--	--	365
EF_a	exposure frequency – adult (days/year)	350/156[a]	260	94	50	10	350
f_f	fraction of absorbed chemical stored in fat	--	--	--	--	--	0.9
f_{fm}	fraction of mother's weight that is fat	--	--	--	--	--	0.3
f_{mbm}	fraction of fat in breast milk	--	--	--	--	--	0.04
h	biological half-life of chemical in the body (days)	--	--	--	--	--	See Table 3
IRS_a	incidental sediment ingestion rate-adults (mg/day)	100	100	100	--	200	--
IRS_c	incidental sediment ingestion rate-children (mg/day)	--	--	200	--	--	--
SA_a	exposed skin surface area – adult (cm^2)	1,980/5,700[b]	1,980/5,700	5,700	3,300	3,300	--
SA_c	exposed skin surface area – child (cm^2)	--	--	2,800	--	--	--
THQ	target hazard quotient	1	1	1	1	1	1
TR	target cancer risk	1×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-6}	1×10^{-6}	--

Notes:
a – 350 days/year fish consumption and 156 days/year sediment contact while fishing
b – beach/in-water sediment

Table B3-2
Chemical-Specific Values
Portland Harbor Superfund Site
Portland, Oregon

Chemical	SF (mg/kg-day)$^{-1}$	Source	RfD (mg/kg-day)	Source	Infant RfD (mg/kg-day)	Source	h (days)	Source	ABS	Source
Antimony			4.00E-03	IRIS						
Arsenic	1.50E+00	IRIS	3.00E-04	IRIS					0.03	EPA 2004
Mercury			1.00E-04	IRIS						
cPAHs (as benzo(a)pyrene	7.30E+00	IRIS	3.00E-04	IRIS					0.13	EPA 2004
Bis(2-ethylhexyl)phthalate	1.40E-02	IRIS	2.00E-02	IRIS					0.1	EPA 2004
Aldrin	1.70E+01	IRIS	3.00E-05	IRIS					0.1	EPA 2004
Dieldrin	1.60E+01	IRIS	5.00E-05	IRIS					0.1	EPA 2004
Chlordane	3.50E-01	IRIS	5.00E-04	IRIS					0.04	EPA 2004
DDx	3.40E-01	IRIS	5.00E-04	IRIS			120	DEQa	0.03	EPA 2004
Hexachlorobenzene	1.60E+00	IRIS	8.00E-04	IRIS					0.1	EPA 2004
Pentachlorophenol	4.00E-01	IRIS	5.00E-03	IRIS					0.25	EPA 2004
PCBs	2.00E+00	IRIS	2.00E-05	IRIS	3.00E-05	ODEQ	2555	DEQ	0.14	EPA 2004
PDBEs			1.00E-04	IRIS	1.00E-04	IRIS	2555	DEQ	0.14	EPA 2004
1,2,3,4,7,8-HxDCF	1.3E+04b	IRIS	7.00E-09	IRIS	7.00E-09	IRIS	2550	DEQ	0.03	EPA 2004
1,2,3,7,8-PeCDD	1.30E+05	IRIS	7.00E-10	IRIS	7.00E-10	IRIS	2550	DEQ	0.03	EPA 2004
2,3,4,7,8-PeCDF	3.90E+04	IRIS	2.30E-09	IRIS	2.30E-09	IRIS	2550	DEQ	0.03	EPA 2004
2,3,7,8-TCDF	1.3E_04	IRIS	7.00E-09	IRIS	7.00E-09	IRIS	2550	DEQ	0.03	EPA 2004
2,3,7,8-TCDD	1.30E+05	IRIS	7.00E-10	IRIS	7.00E-10	IRIS	2550	DEQ	0.03	EPA 2004

Notes:

a – DEQ 2010 Appendix D

b – CSF and RfDs for congeners other than 2,3,7,8-TCDD calculated using the TEF methodology in EPA 2010

Table B3-3
Whole Body/Fillet Concentration Ratios
Portland Harbor Superfund Site
Portland, Oregon

Contaminant	Smallmouth Bass	Carp	Black Crappie	Brown Bullhead
Aldrin[a]	5.77	1.36	12	10.46
Chlordane	5.92	1.4	12	10.46
Dieldrin	5.77	1.36	12b	10.46[b]
DDx[c]	7.17	1.42	6.32	4.06
PCBs	8.02	1.82	5.46	1.56
Total Dioxins/Furans	6.13	1.52	6.13	1.52

Notes:

a – not measured, based on dieldrin
b – not measured, based on chlordane
c – average of DDD, DDE, and DDT

Table B3-4
Risk-Based Human Health PRGs for RAO 1
Portland Harbor Superfund Site
Portland, Oregen

			Beach Sediment (Direct Contact)					In-water Sediment (Direct Contact)				
			Dockside Worker	Transient	Recreational Beach User HQ=child	High Frequency Fisher	Tribal Fisher	In-water Worker	High Frequency Fisher	Tribal Fisher	Diver Wet Suit	Diver Dry Suit
COCs	**Target Risk Level**	**Units**										
Arsenic	10^{-6}	mg/kg	4	7	0.7	1.7	0.4	54	3.8	1.0	45	NA
	10^{-4}	mg/kg	434	698	75	168	43	5,425	376	97	4,471	NA
	HQ=1	mg/kg	697	1,122	37	325	195	3,487	724	435	7,185	NA
Aldrin	10^{-6}	µg/kg	316	460	29	83	21	3,955	205	53	1,416	NA
	10^{-4}	µg/kg	31,641	46,042	2,947	8,295	2,133	395,511	20,548	5,284	141,572	NA
	HQ=1	µg/kg	57,632	83,862	1,555	18,131	10,879	288,158	44,913	26,948	257,864	NA
Chlordanes	10^{-6}	µg/kg	18,057	28,547	2,719	6,484	1,667	225,707	14,803	3,807	152,651	NA
	10^{-4}	µg/kg	1,805,654	2,854,749	271,939	648,385	166,728	22,570,671	1,480,315	380,652	15,265,123	NA
	HQ=1	µg/kg	1,128,534	1,784,218	51,128	486,289	291,773	5,642,668	1,110,236	666,142	9,540,702	NA
DDx	10^{-6}	µg/kg	19,146	30,807	3,293	7,429	1,910	239,322	16,573	4,262	197,246	NA
	10^{-4}	µg/kg	1,914,575	3,080,699	329,319	742,891	191,029	23,932,184	1,657,320	426,168	19,724,562	NA
	HQ=1	µg/kg	1,162,420	1,870,425	61,028	541,249	324,750	5,812,102	1,207,476	724,486	11,975,627	NA
Dieldrin	10^{-6}	µg/kg	336	489	31	88	23	4,202	218	56	1,504	NA
	10^{-4}	µg/kg	33,618	48,920	3,131	8,814	2,266	420,230	21,833	5,614	150,421	NA
	HQ=1	µg/kg	96,053	139,770	2,591	30,218	18,131	480,263	74,855	44,913	429,773	NA
Dioxins/Furans (2,3,7,8-TCDD eq)	10^{-6}	µg/kg	0.05	0.08	0.009	0.02	0.005	0.6	0.04	0.01	0.5	NA
	10^{-4}	µg/kg	5	8.1	0.9	1.9	0.5	63	4	1	52	NA
	HQ=1	µg/kg	1.6	2.6	0.09	0.8	0.5	8.1	1.7	1	17	NA
Bis-2-Ethylhexylphthalate	10^{-6}	µg/kg	384,211	559,081	35,787	100,727	25,901	4,802,632	249,516	64,161	NA	NA
	10^{-4}	µg/kg	38,421,053	55,908,096	3,578,688	10,072,697	2,590,122	480,263,158	24,951,562	6,416,116	NA	NA
	HQ=1	µg/kg	38,421,053	55,908,096	1,036,382	12,087,236	7,252,342	192,105,263	29,941,874	17,965,124	NA	NA
Hexachlorobenzene	10^{-6}	µg/kg	3,362	4,892	313	881	227	42,023	2,183	561	15,042	NA
	10^{-4}	µg/kg	336,184	489,196	31,314	88,136	22,664	4,202,303	218,326	56,141	1,504,205	NA
	HQ=1	µg/kg	1,536,842	2,236,324	41,455	483,489	290,094	7,684,211	1,197,675	718,605	6,876,367	NA
PCBs	10^{-6}	µg/kg	2,447	3,420	190	563	145	30,583	1,435	369	8,807	NA
	10^{-4}	µg/kg	244,665	341,969	19,039	56,299	14,477	3,058,300	143,500	36,900	880,700	NA
	HQ=1	µg/kg	34,952	48,853	780	9,651	5,791	174,761	24,599	14,760	125,816	NA
cPAHs	10^{-6}	µg/kg	686	967	12	162	42	8,572	411	106	2,586	NA
	10^{-4}	µg/kg	68,579	96,742	1,167	16,243	4,177	857,243	41,150	10,581	258,626	NA
	HQ=1	µg/kg	536,389	756,663	NA	152,450	91,470	2,681,945	386,218	231,731	2,022,828	NA
PBDEs	10^{-6}	µg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10^{-4}	µg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	HQ=1	µg/kg	174,761	NA	3,900	48,256	28,954	873,803	122,996	73,798	629,078	NA

Notes:
NA = not available
ND = non-detect

Table B3-5
Risk-Based Human Health PRGs for RAO 2
Portland Harbor Superfund Site
Portland, Oregon

			Fish Consumption (Tissue)		Fish/Shellfish Consumption (Sediment)		Fish Consumption (Tissue)		Fish/Shellfish Consumption (Sediment)	
			142 g/day HQ=child	142 g/day Infant	142 g/day	142 g/day Infant	49 g/day HQ=child	49 g/day Infant	49 g/day	49 g/day Infant
COCs	**Target Risk Level**	**Units**	Fillet	Fillet			Fillet	Fillet		
Arsenic	10^{-6}	mg/kg	0.001	NA	NA	NA	NA	NA	NA	NA
	10^{-4}	mg/kg	0.1	NA	NA	NA	NA	NA	NA	NA
	HQ=1	mg/kg	0.08	NA	NA	NA	NA	NA	NA	NA
Mercury	10^{-6}	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA
	10^{-4}	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA
	HQ=1	mg/kg	26	NA	NA	NA	NA	NA	NA	NA
Aldrin	10^{-6}	µg/kg	0.06	NA	2.0	NA	0.17	NA	5.5	NA
	10^{-4}	µg/kg	6	NA	194	NA	17	NA	560	NA
	HQ=1	µg/kg	7.9	NA	260	NA	23	NA	757	NA
Chlordanes	10^{-6}	µg/kg	3	NA	1.5	NA	8.3	NA	9.0	NA
	10^{-4}	µg/kg	288	NA	404	NA	830	NA	1,160	NA
	HQ=1	µg/kg	131	NA	181	NA	380	NA	524	NA
DDx	10^{-6}	µg/kg	3	NA	6.1	NA	9	NA	20.3	NA
	10^{-4}	µg/kg	296	NA	705	NA	900	NA	2,116	NA
	HQ=1	µg/kg	131	94	307	220	380	258	893	606
Dieldrin	10^{-6}	µg/kg	0.06	NA	0.07	NA	0.18	NA	0.40	NA
	10^{-4}	µg/kg	6	NA	19	NA	18	NA	56	NA
	HQ=1	µg/kg	13	NA	40	NA	38	NA	118	NA
1,2,3,4,7,8-HxCDF	10^{-6}	µg/kg	0.00008	NA	0.0003	NA	0.00022	NA	0.00007	NA
	10^{-4}	µg/kg	0.008	NA	0.03	NA	0.022	NA	0.122	NA
	HQ=1	µg/kg	0.002	0.00006	0.007	0.0002	0.005	0.00017	0.003	0.00006
1,2,3,7,8-PeCDD	10^{-6}	µg/kg	0.000008	NA	0	NA	0.000022	NA	0.00001	NA
	10^{-4}	µg/kg	0.0008	NA	0.001	NA	0.0022	NA	0.001	NA
	HQ=1	µg/kg	0.0002	0.000006	0.0003	0	0.0005	0.000017	0.003	0.00001
2,3,4,7,8-PeCDF	10^{-6}	µg/kg	0.00003	NA	0.0002	NA	0.00007	NA	0.0005	NA
	10^{-4}	µg/kg	0.003	NA	0.02	NA	0.007	NA	0.05	NA
	HQ=1	µg/kg	0.0006	0.00002	0.004	0.0001	0.0018	0.00006	0.01	0.0004
2,3,7,8-TCDD	10^{-6}	µg/kg	0.000008	NA	0	NA	0.000022	NA	0.000013	NA
	10^{-4}	µg/kg	0.0008	NA	0.001	NA	0.0022	NA	0.004	NA
	HQ=1	µg/kg	0.0002	0.000006	0.0003	0	0.0005	0.000017	0.008	0.000006
2,3,7,8-TCDF	10^{-6}	µg/kg	0.00008	NA	0.0006	NA	0.00022	NA	0.0014	NA
	10^{-4}	µg/kg	0.008	NA	0.06	NA	0.0220	NA	0.16	NA
	HQ=1	µg/kg	0.002	0.00006	0.01	0.0004	0.005	0.00017	0.04	0.0013
Bis-2-Ethylhexylphthalate	10^{-6}	µg/kg	72	NA	NA	NA	NA	NA	NA	NA
	10^{-4}	µg/kg	7,200	NA	NA	NA	NA	NA	NA	NA
	HQ=1	µg/kg	5,246	NA	NA	NA	NA	NA	NA	NA
Hexachlorobenzene	10^{-6}	µg/kg	0.6	NA	NA	NA	2.0	NA	NA	NA
	10^{-4}	µg/kg	63	NA	NA	NA	200	NA	NA	NA
	HQ=1	µg/kg	NA	NA	NA	NA	608	NA	NA	NA

Table B3-5
Risk-Based Human Health PRGs for RAO 2
Portland Harbor Superfund Site
Portland, Oregon

			Fish Consumption (Tissue)		Fish/Shellfish Consumption (Sediment)		Fish Consumption (Tissue)		Fish/Shellfish Consumption (Sediment)	
			142 g/day HQ=child	142 g/day Infant	142 g/day	142 g/day Infant	49 g/day HQ=child	49 g/day Infant	49 g/day	49 g/day Infant
COCs	**Target Risk Level**	**Units**	Fillet	Fillet			Fillet	Fillet		
PCBs	10^{-6}	µg/kg	0.5	NA	0	NA	1.5	NA	0.31	NA
	10^{-4}	µg/kg	50	NA	20	NA	150	NA	60	NA
	HQ=1	µg/kg	5	0.25	2	0	15	0.73	5.8	0.29
cPAHs	10^{-6}	µg/kg	7.1[a]	NA	3,950	NA	0.13	NA	NA	NA
	10^{-4}	µg/kg	711	NA	8,500,000	NA	13	NA	NA	NA
	HQ=1	µg/kg	NA	NA	NA	NA	NA	NA	NA	NA
Pentachlorophenol	10^{-6}	µg/kg	2.5	NA	NA	NA	7	NA	NA	NA
	10^{-4}	µg/kg	250	NA	NA	NA	7,300	NA	NA	NA
	HQ=1	µg/kg	1,311	NA	NA	NA	3,800	NA	NA	NA
PBDEs	10^{-6}	µg/kg	NA	NA	NA	NA	NA	NA	NA	NA
	10^{-4}	µg/kg	NA	NA	NA	NA	NA	NA	NA	NA
	HQ=1	µg/kg	26	0.84	NA	NA	76	4.20	NA	NA

Notes:
a - tissue concentration based on a shellfish consumption rate of 3.3 g/day
NA = not available
ND = non-detect

Table B4-1
Risk-Based Ecological PRGs for RAO 5
Portland Harbor Superfund Site
Portland, Oregon

COCs	**Target Risk Level**	**Units**	Direct Exposure to Sediment					
			Benthic					
			Clams	Crayfish	Worms	LRM	FPM	PEC
Cadmium	HQ=1	mg/kg					0.51	4.98
Chlordane	HQ=1	µg/kg				1.4		
Copper	HQ=1	mg/kg	NA		NA		359	149
DDD	HQ=1	µg/kg				117	114	
DDE	HQ=1	µg/kg				359	906	31
DDT	HQ=1	µg/kg					246	
DDx	HQ=1	µg/kg	578	2450				63
Dieldrin	HQ=1	µg/kg					22	62
Lindane	HQ=1	µg/kg						4.99
Lead	HQ=1	mg/kg				196		128
Mercury	HQ=1	mg/kg				0.085	0.235	1.06
PCBs	HQ=1	µg/kg	2420	1370		587	500	676
PAHs	HQ=1	mg/kg				23,000	NA	22,800
TBT	HQ=1	mg/kg	NA			3080		NA
TPH (diesel)	HQ=1	mg/kg				91		
Zinc	HQ=1	mg/kg	NA					459

Note: Highlighted values are those selected as the representative PRG for RAO 5.

Table B4-2
Risk-Based Ecological PRGs for RAO 6
Portland Harbor Superfund Site
Portland, Oregon

			Tissue Residual Assessment						
			Invertivore		Omnivore		Piscivore		Detrivore
			Sculpin	Peamouth	Brown Bullhead	Largescale Sucker	Northern Pikeminnow	Smallmouth Bass	Pacific Lamprey
COCs	**Target Risk Level**	**Units**							
Bis-2-Ethylhexylphthalate	HQ=1	µg/kg	400			NA		135	
Cadmium	HQ=1	mg/kg							
Copper	HQ=1	mg/kg	NA						NA
DDE	HQ=1	µg/kg							
DDx	HQ=1	µg/kg	760				NA		
1,2,3,4,7,8-HxCDF	HQ=1	µg/kg							
1,2,3,7,8-PeCDD	HQ=1	µg/kg							
2,3,4,7,8-PeCDF	HQ=1	µg/kg							
2,3,7,8-TCDD	HQ=1	µg/kg							
2,3,7,8-TCDF	HQ=1	µg/kg							
Mercury	HQ=1	mg/kg							
PCBs	HQ=1	µg/kg	272			152	85.5	64	
TBT	HQ=1	mg/kg							

* = PRG calculated from a µg/kg organic carbon (OC) sediment value normalized to a bulk sediment PRG with units of µg/kg dw using the site-wide mean sediment organic carbon content of 1.71%.

Table B4-2
Risk-Based Ecological PRGs for RAO 6
Portland Harbor Superfund Site
Portland, Oregon

COCs	Fish Dietary Assessment								Bird Egg Assessment	
	Invertivore			Omnivore		Piscivore		Detrivore	Piscivore	
	Sculpin	Peamouth	Juvenile Chinook	Largescale Sucker	White Sturgeon	Northern Pikeminnow	Smallmouth Bass	Pacific Lamprey	Osprey	Bald Eagle
	clams worms sculpin	clams worms sculpin	clams worms multiplates	clams worms	clams worms	carp crayfish largescale sucker northern pikeminnow peamouth sculpin worms	crayfish sculpin worms		population	population
Bis-2-Ethylhexylphthalate										
Cadmium	NA		NA							
Copper	NA	NA	NA	NA	NA	NA				
DDE										
DDx	NA									
1,2,3,4,7,8-HxCDF									0.03	0.05
1,2,3,7,8-PeCDD									0.001	0.002
2,3,4,7,8-PeCDF									0.004	0.006
2,3,7,8-TCDD									0.0008	0.001
2,3,7,8-TCDF									0.004	0.007
Mercury	NA									
PCBs	NA								63	110
TBT	NA									

* = PRG calculated from a µg/kg organic carbon (OC) sediment value normalized to a bulk sediment PRG with units of µg/kg dw using the site-wide mean sediment organic carbon content of 1.71%.

Table B4-2
Risk-Based Ecological PRGs for RAO 6
Portland Harbor Superfund Site
Portland, Oregon

	Bird Dietary Assessment						Mammal Dietary Assessment	
	Piscivore			Omnivore	Sediment Probing Invertivore		Aquatic-Dependent Carnivore	
	Osprey	Bald Eagle	Belted Kingfisher	Hooded Merganser	Spotted Sandpiper		Mink	River Otter
COCs	carp brown bullhead largescale sucker northern pikeminnow smallmouth bass	carp largescale sucker northern pikeminnow peamouth	chinook salmon clam peamouth sculpin	clams worms peamouth sculpin	clams	worms	carp crayfish sculpin smallmouth bass	clams carp crayfish sculpin smallmouth bass
Bis-2-Ethylhexylphthalate			NA					
Cadmium								
Copper					NA	NA		
DDE			11.7		420	226		
DDx					4,439	2,849		
1,2,3,4,7,8-HxCDF	17	45			6	0.9	0.2	
1,2,3,7,8-PeCDD	0.5	1.5			0.3	0.09	0.008	
2,3,4,7,8-PeCDF	2	6			1	0.1	0.1	
2,3,7,8-TCDD	0.4	1.2			0.3	0.1	0.006	
2,3,7,8-TCDF	2.4	6.5			0.6	0.1	0.4	
Mercury			NA					
PCBs	428	1,306	51	622	1,002	609	36	62
TBT								

* = PRG calculated from a µg/kg organic carbon (OC) sediment value normalized to a bulk sediment PRG with units of µg/kg dw using the site-wide mean sediment organic carbon content of 1.71%.

Figures

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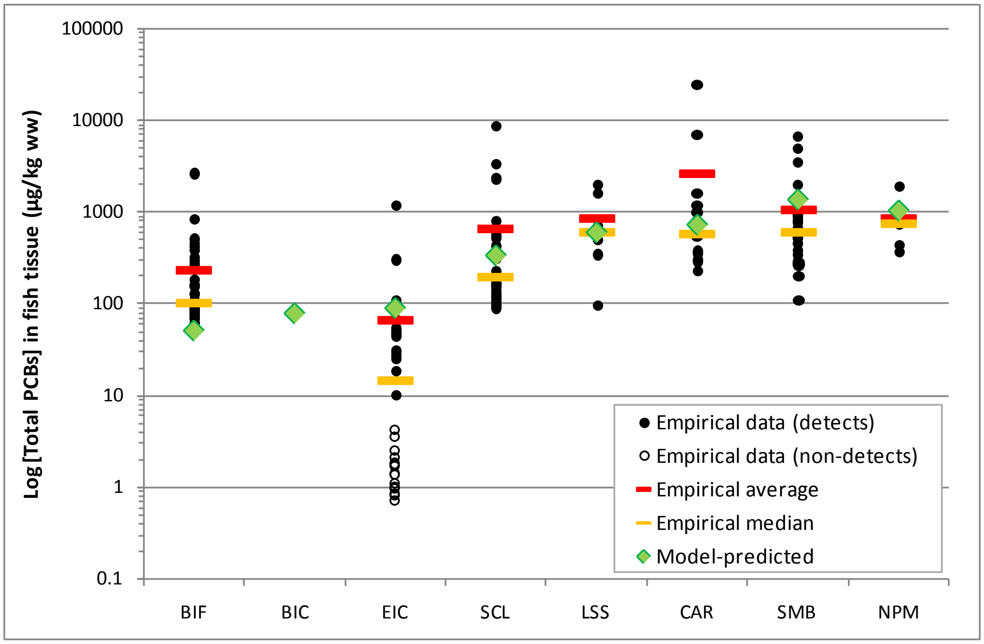

Figure B1-1
Empirical and Model-Predicted Data for Total PCBs

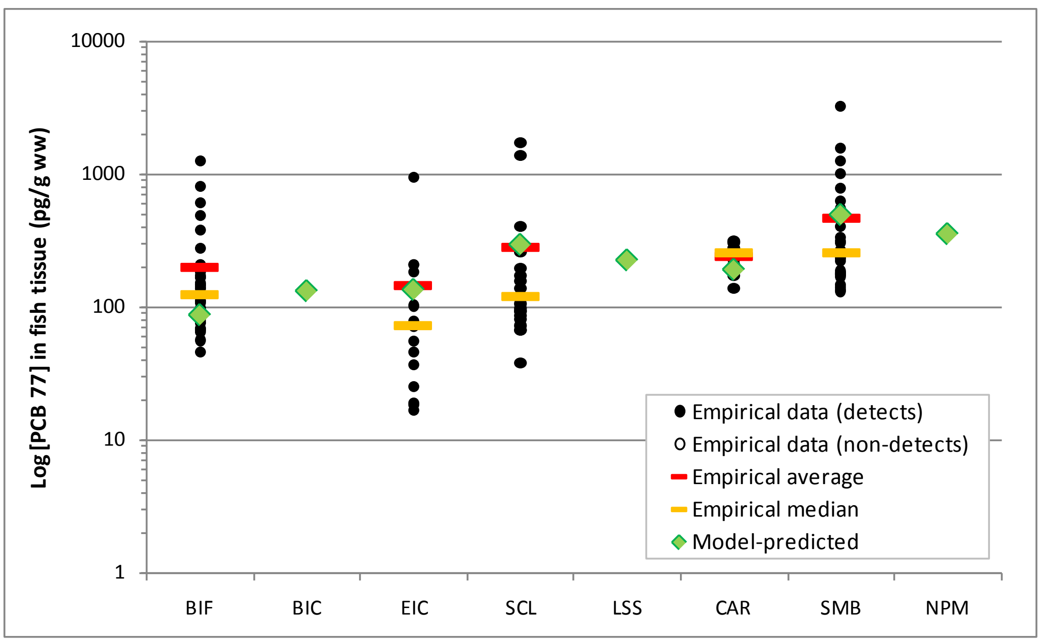

Figure B1-2
Empirical and Model-Predicted Data for PCB 77

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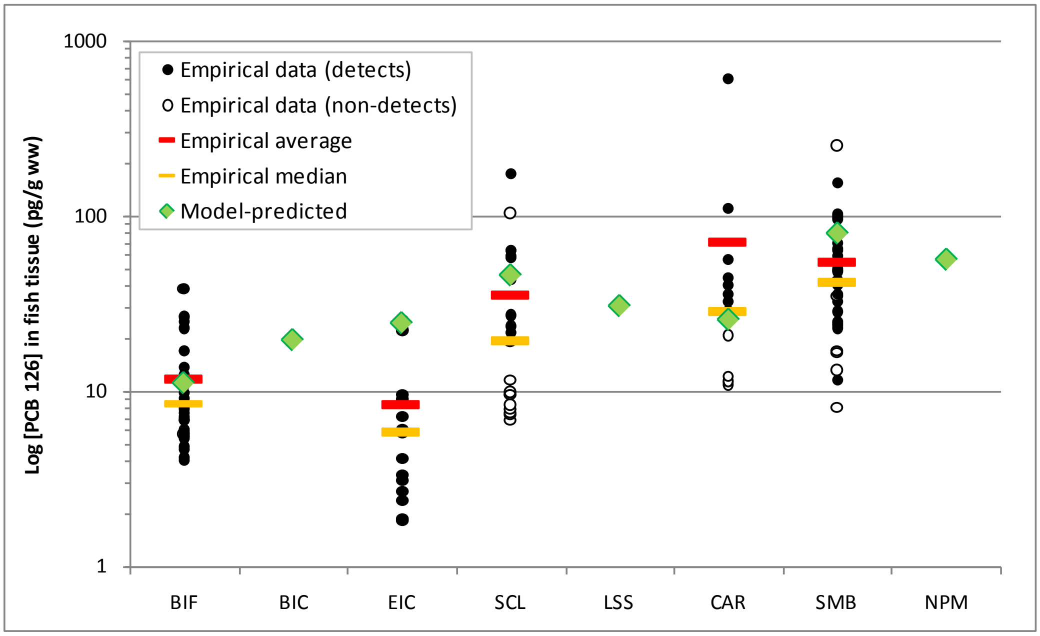

Figure B1-3
Empirical and Model-Predicted Data for PCB 126

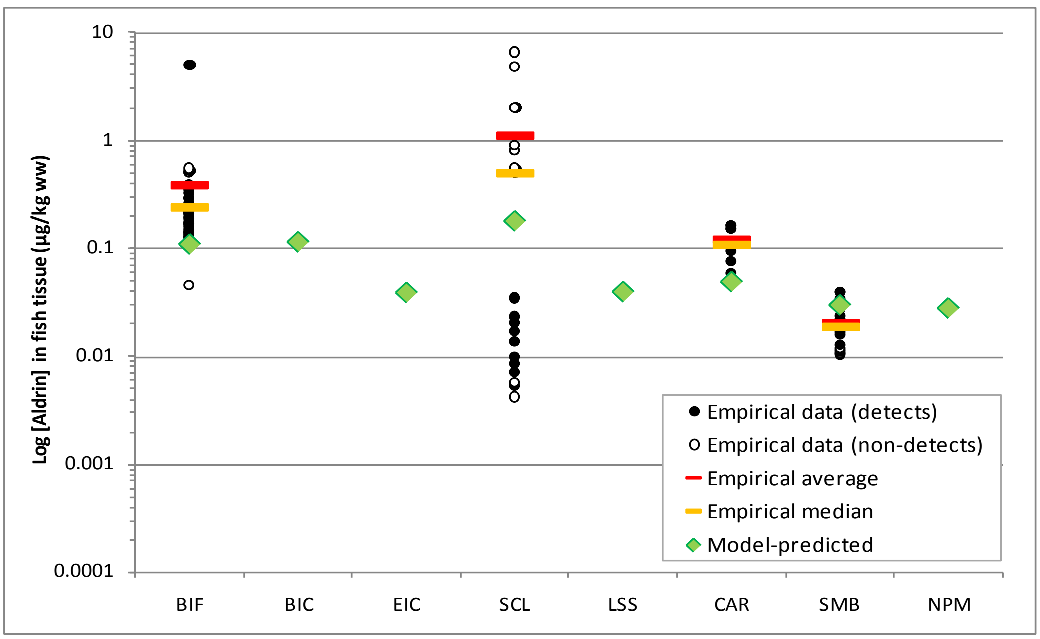

Figure B1-4
Empirical and Model-Predicted Data for Aldrin

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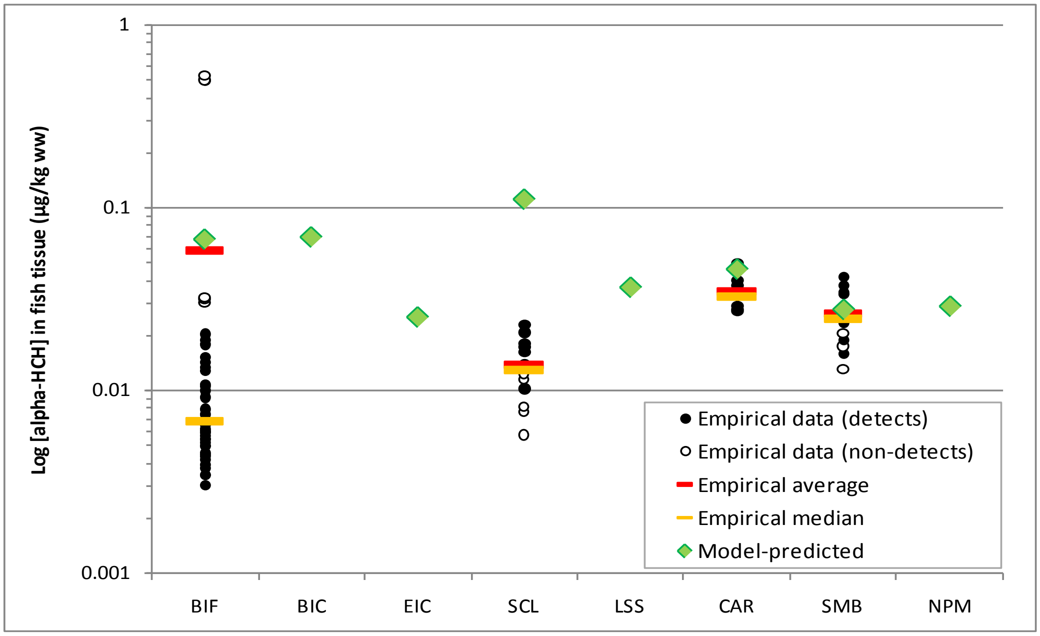

Figure B1-5
Empirical and Model-Predicted Data for α-Hexachlorocyclohexane

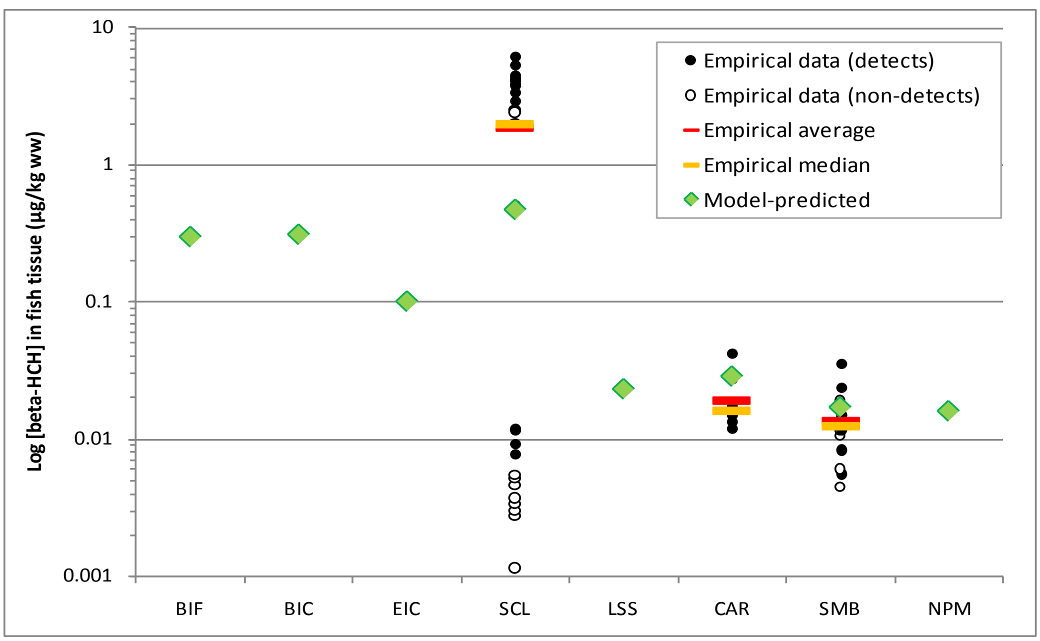

Figure B1-6
Empirical and Model-Predicted Data for β-Hexachlorocyclohexane

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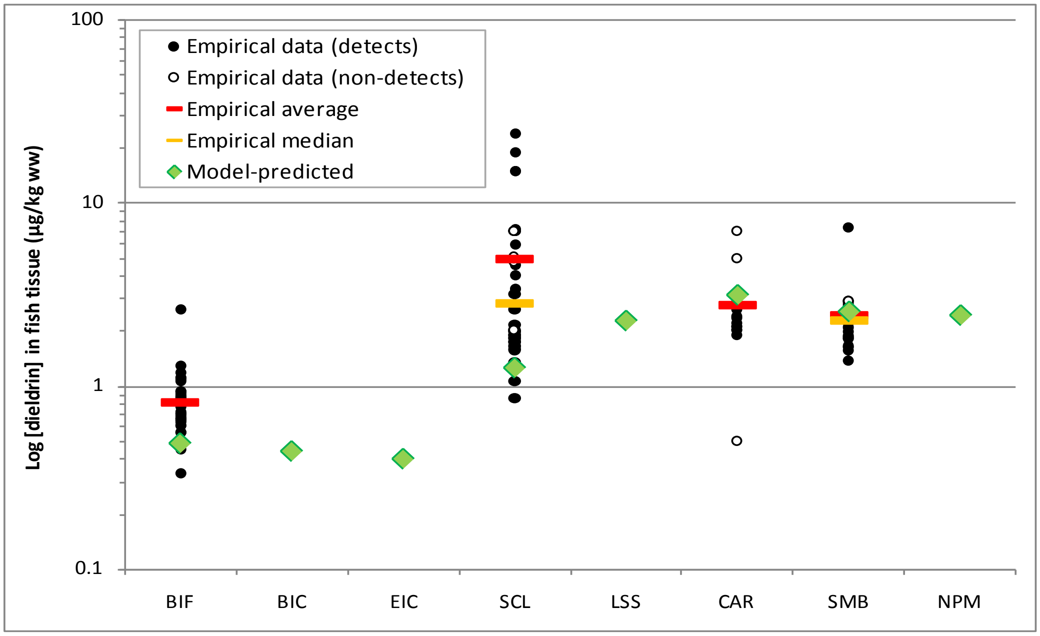

Figure B1-7
Empirical and Model-Predicted Data for Dieldrin

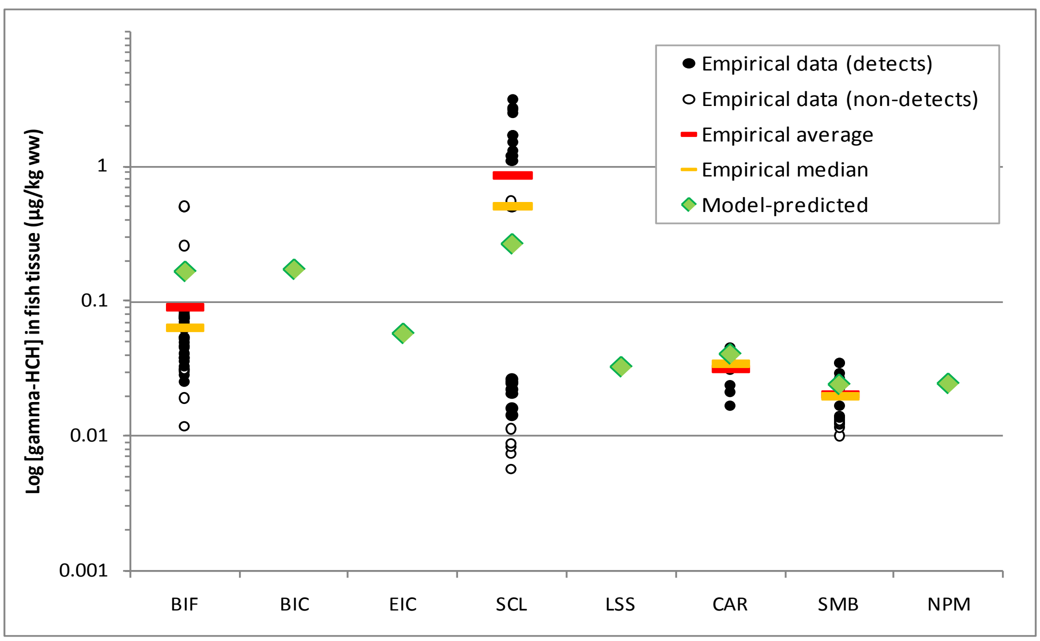

Figure B1-8
Empirical and Model-Predicted Data for γ-Hexachlorocyclohexane

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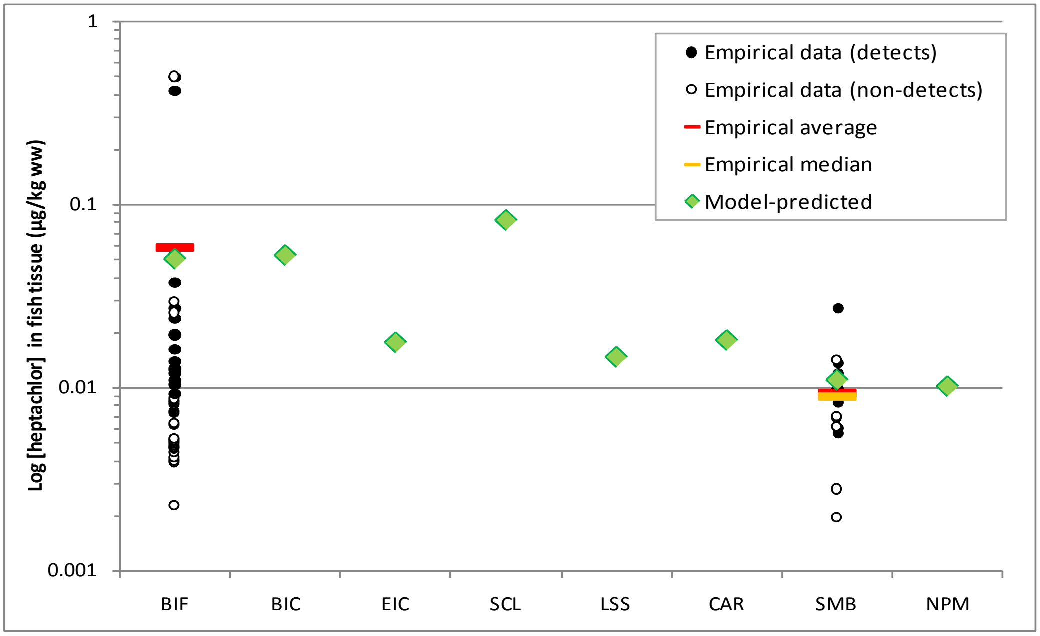

Figure B1-9
Empirical and Model-Predicted Data for Heptachlor

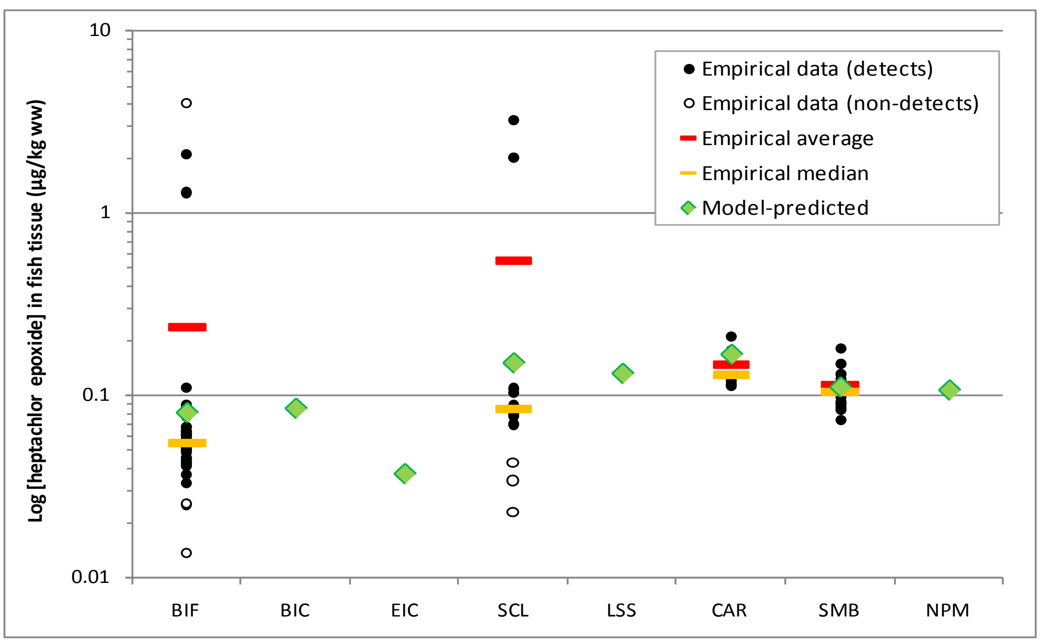

Figure B1-10
Empirical and Model-Predicted Data for Heptachlor Epoxide

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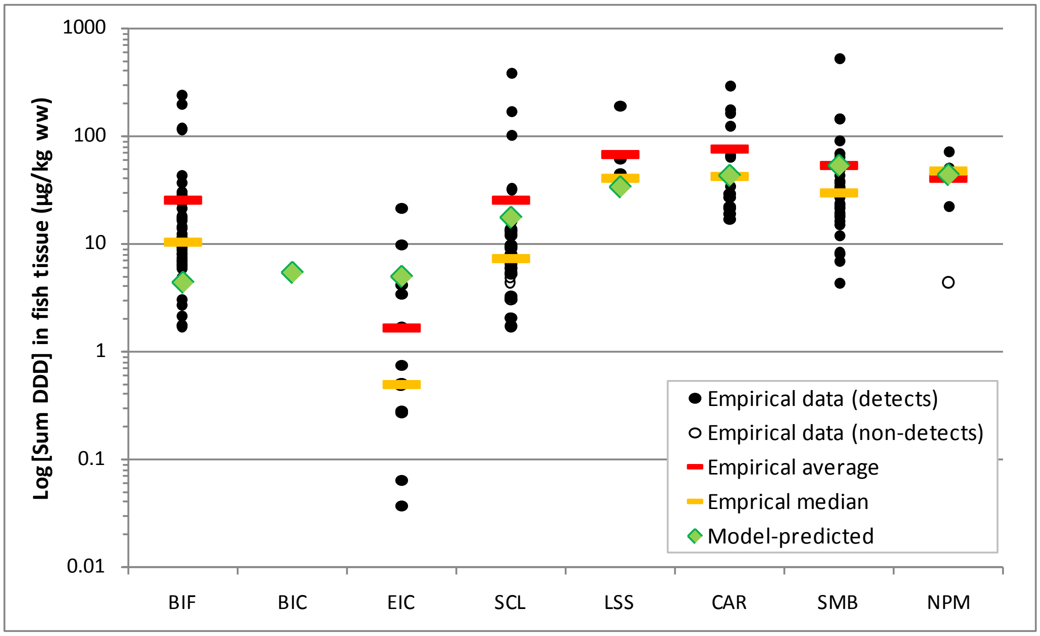

Figure B1-11
Empirical and Model-Predicted Data for Sum DDD

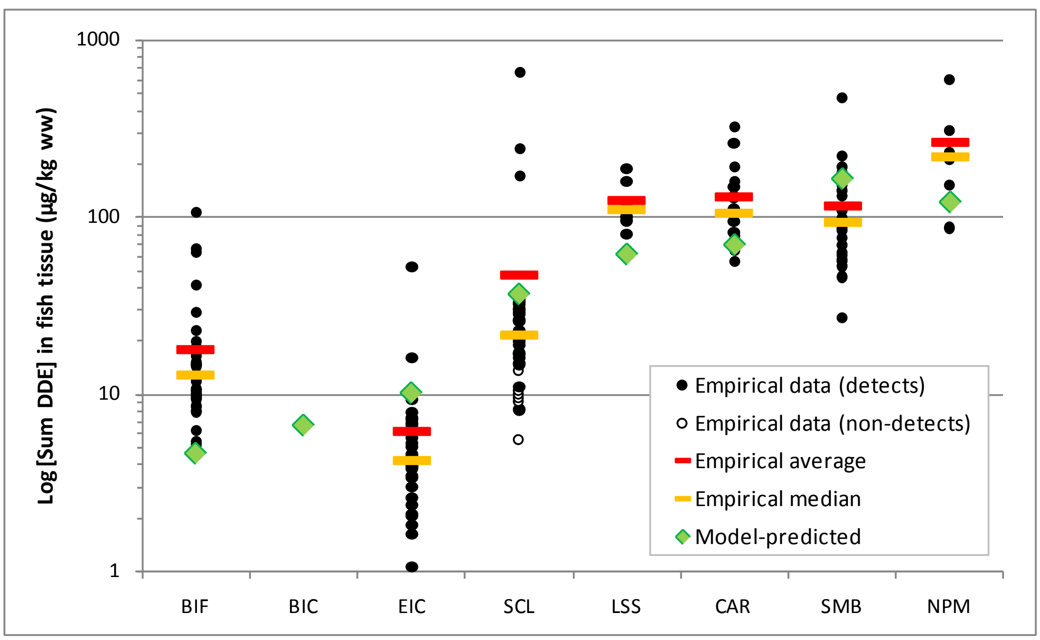

Figure B1-12
Empirical and Model-Predicted Data for Sum DDE

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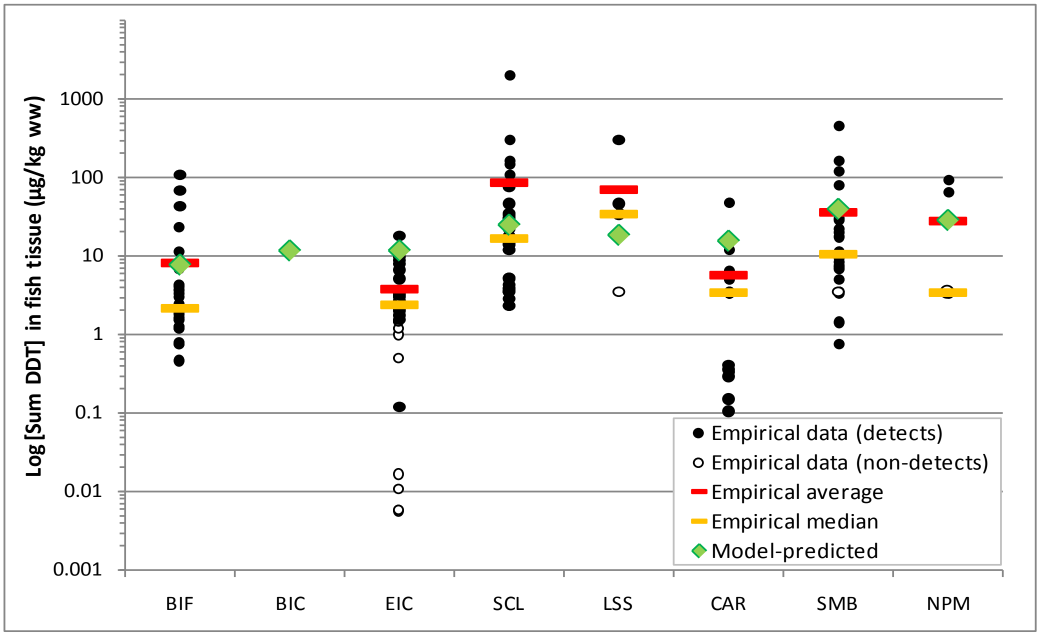

Figure B1-13
Empirical and Model-Predicted Data for Sum DDT

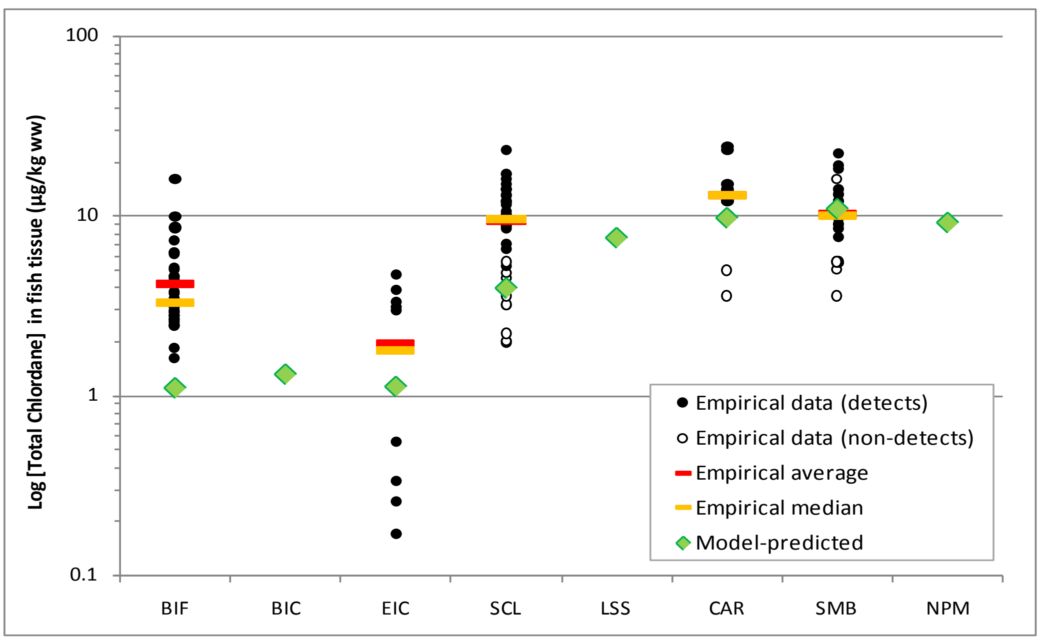

Figure B1-14
Empirical and Model-Predicted Data for Total Chlordane

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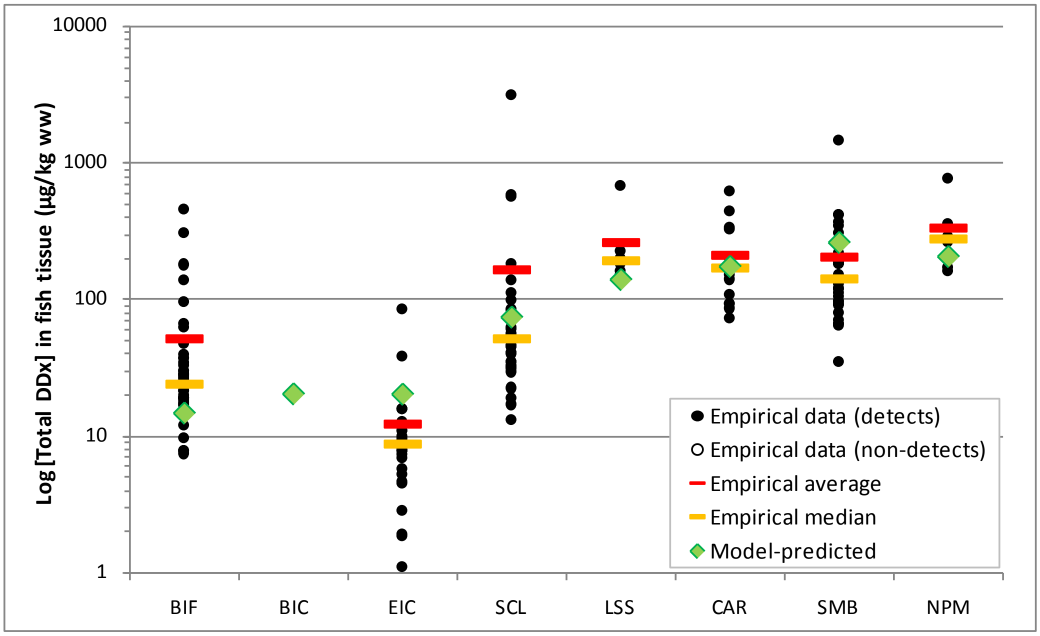

Figure B1-15
Empirical and Model-Predicted Data for DDx

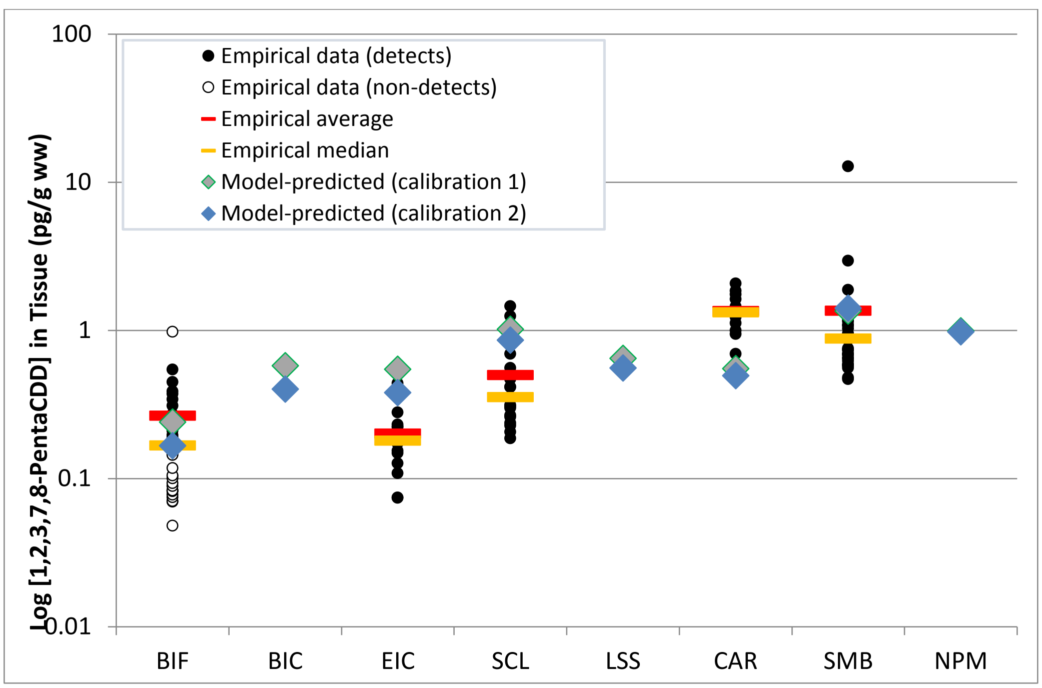

Figure B1-16
Empirical and Model-Predicted Data for 1,2,3,7,8-PentaCDD

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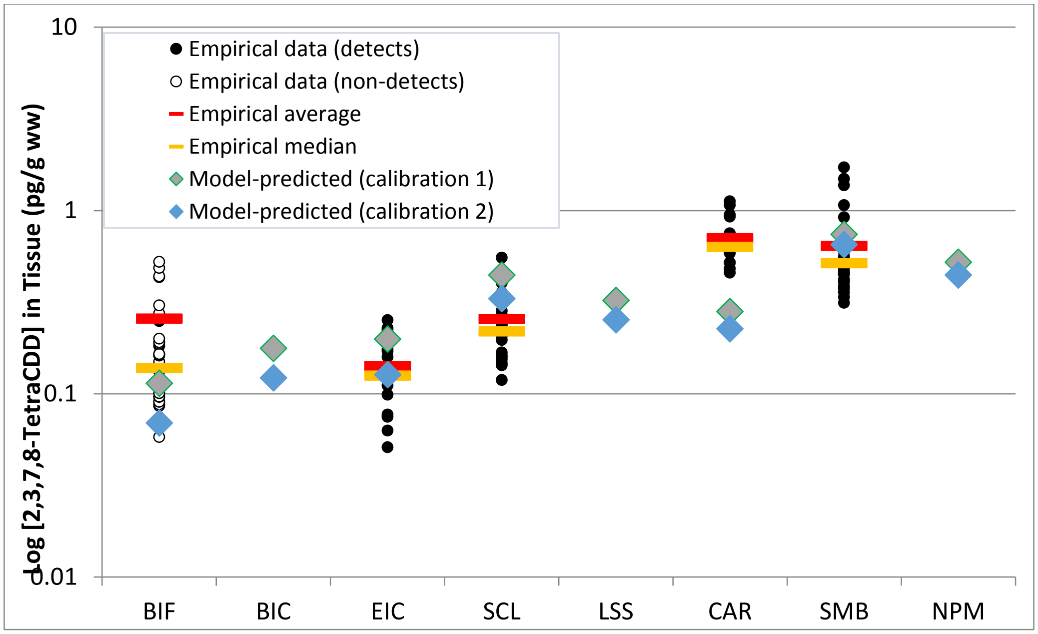

Figure B1-17
Empirical and Model-Predicted Data for 2,3,7,8-TetraCDD

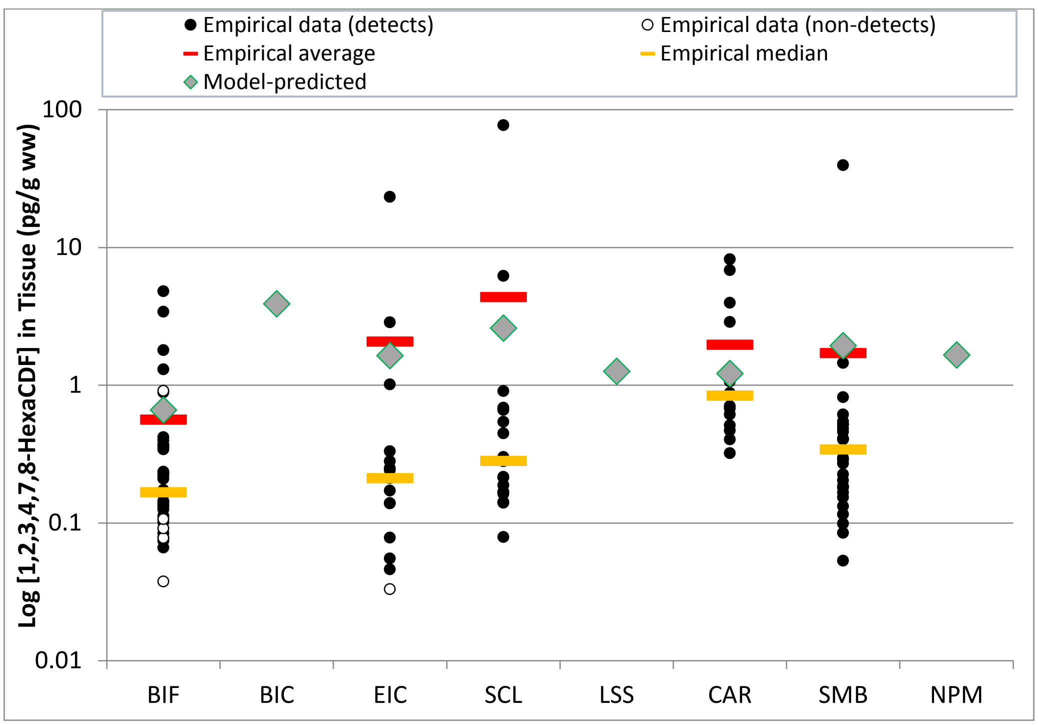

Figure B1-18
Empirical and Model-Predicted Data for 1,2,3,4,7,8-HexaCDF

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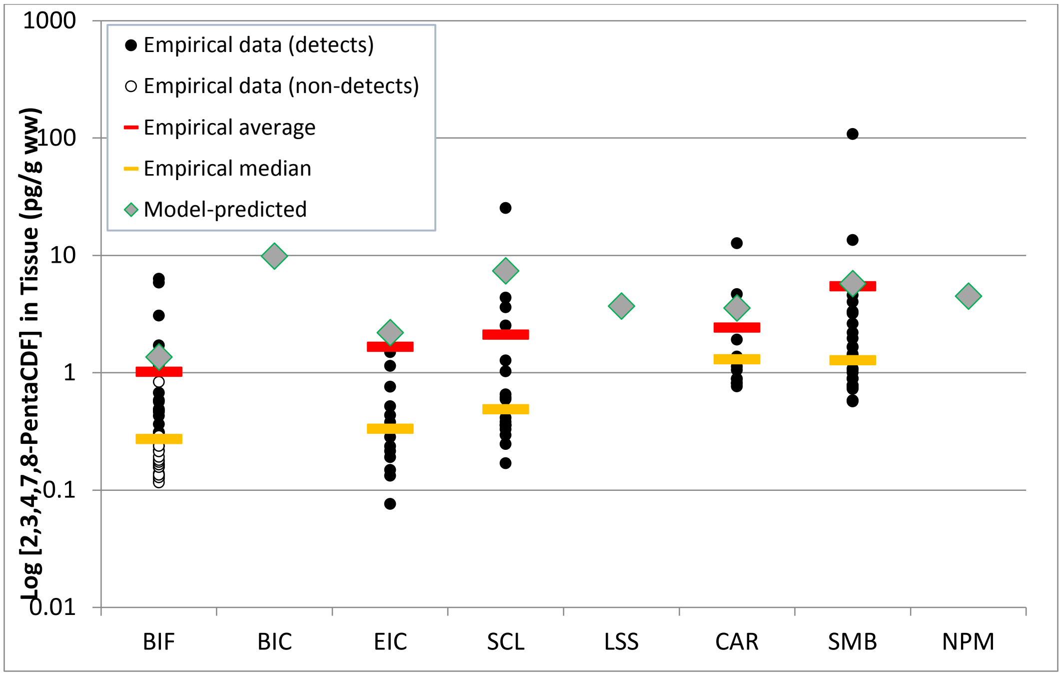

Figure B1-19
Empirical and Model-Predicted Data for 2,3,4,7,8-PentaCDF

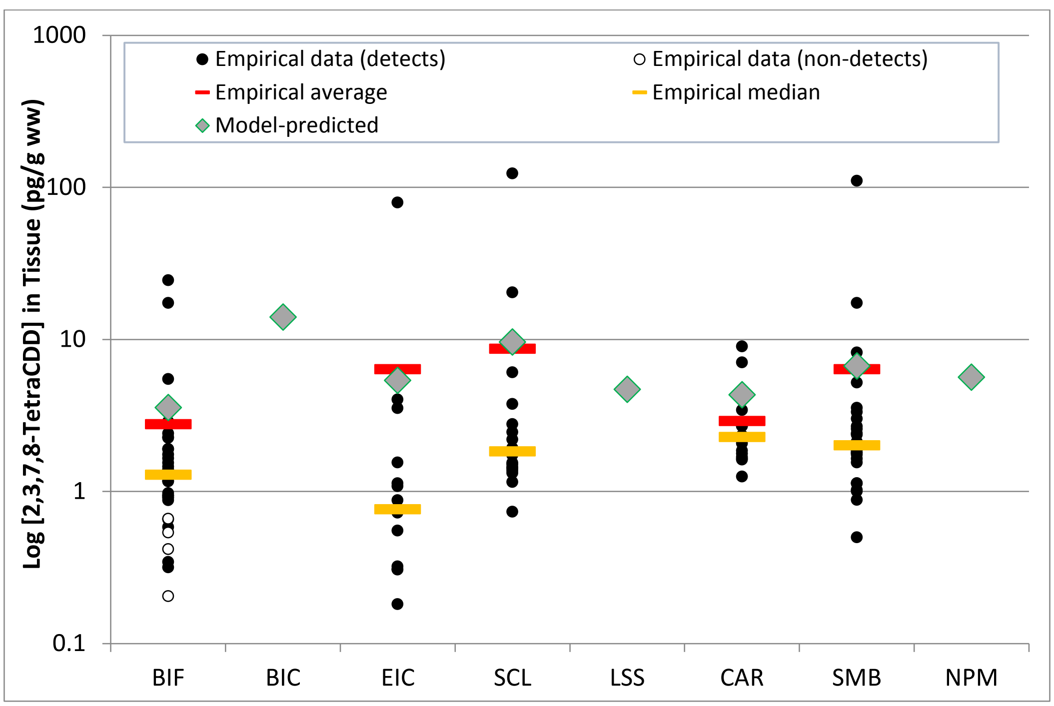

Figure B1-20
Empirical and Model-Predicted Data for 2,3,7,8-TetraCDF

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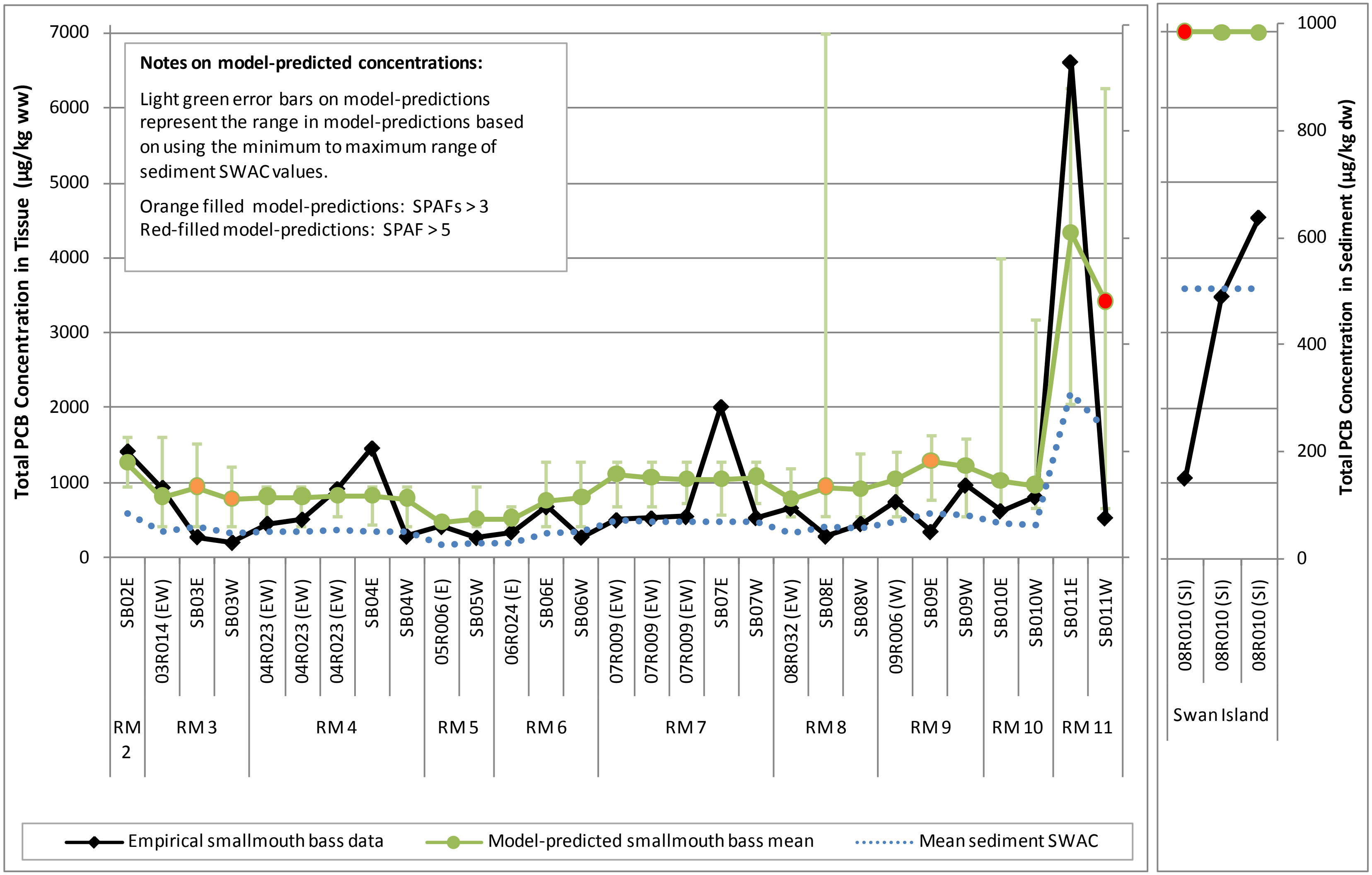

Figure B1-21

Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for Total PCBs for RM 2 through RM 11 and for Swan Island Lagoon

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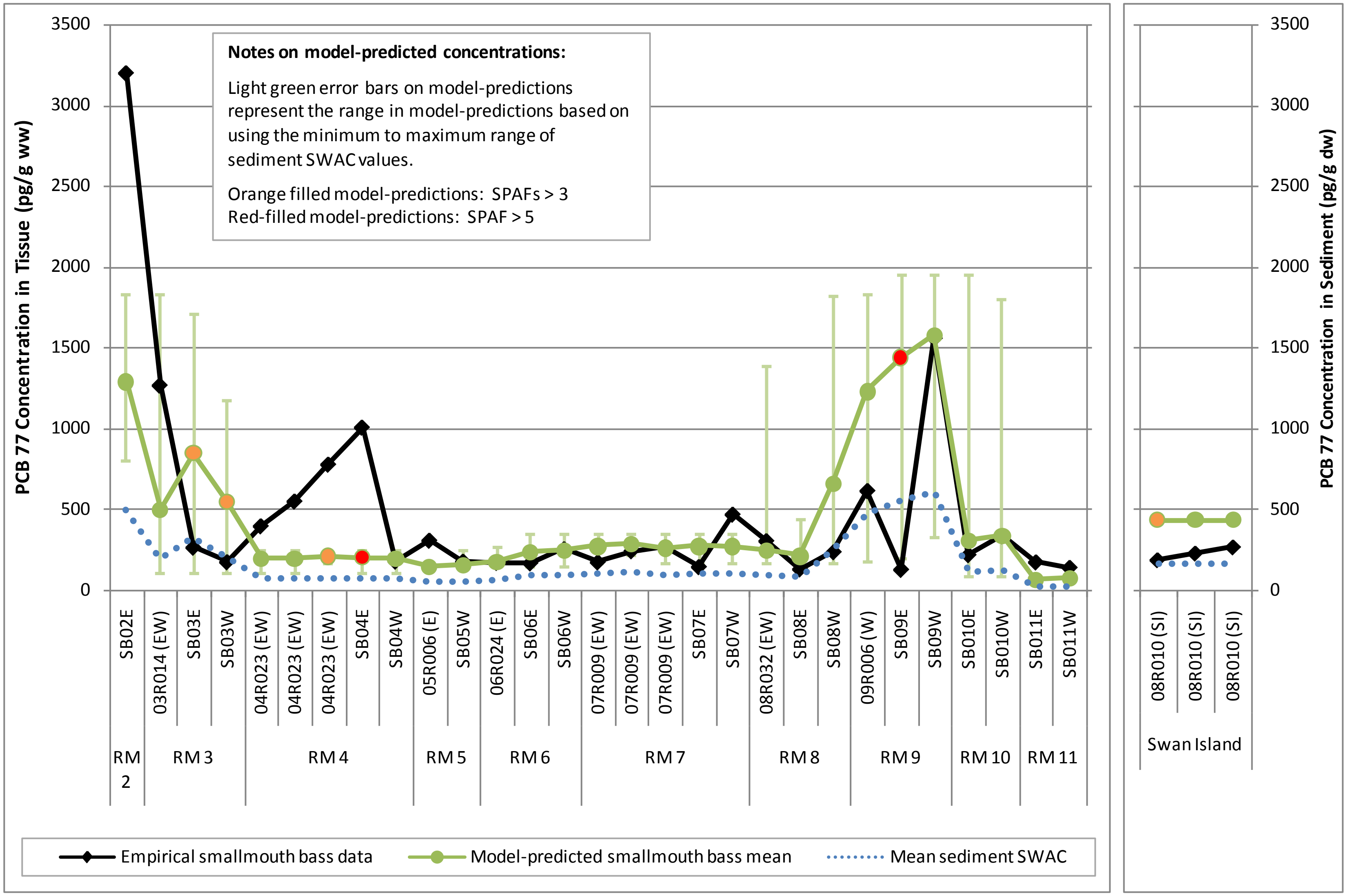

Figure B-1-22
Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for PCB 77 for RM 2 through RM 11 and for Swan Island Lagoon

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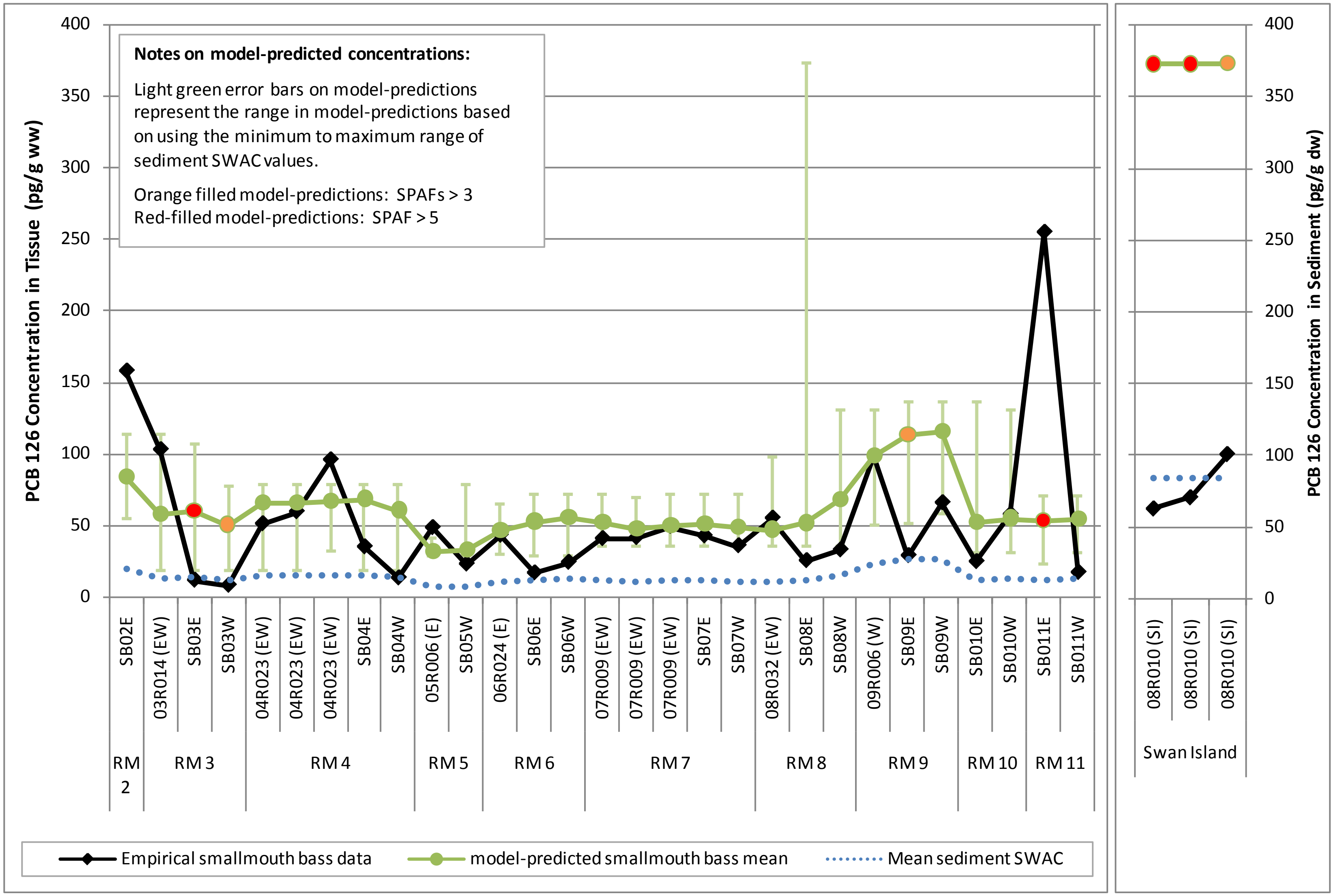

Figure B1-23

Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for PCB 126 for RM 2 through RM 11 and for Swan Island Lagoon

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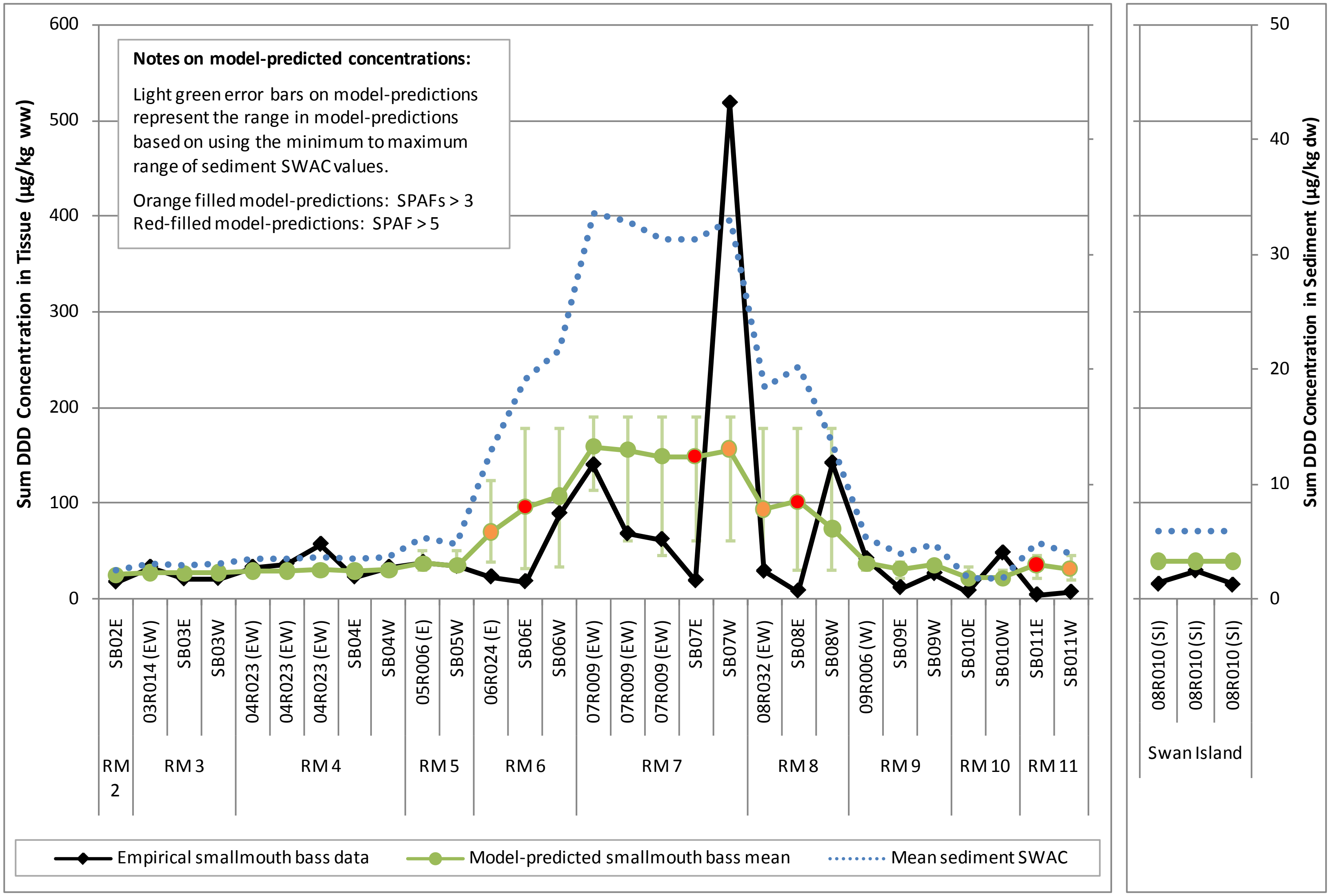

Figure B1-24

Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for Sum DDD for RM 2 through RM 11 and for Swan Island Lagoon

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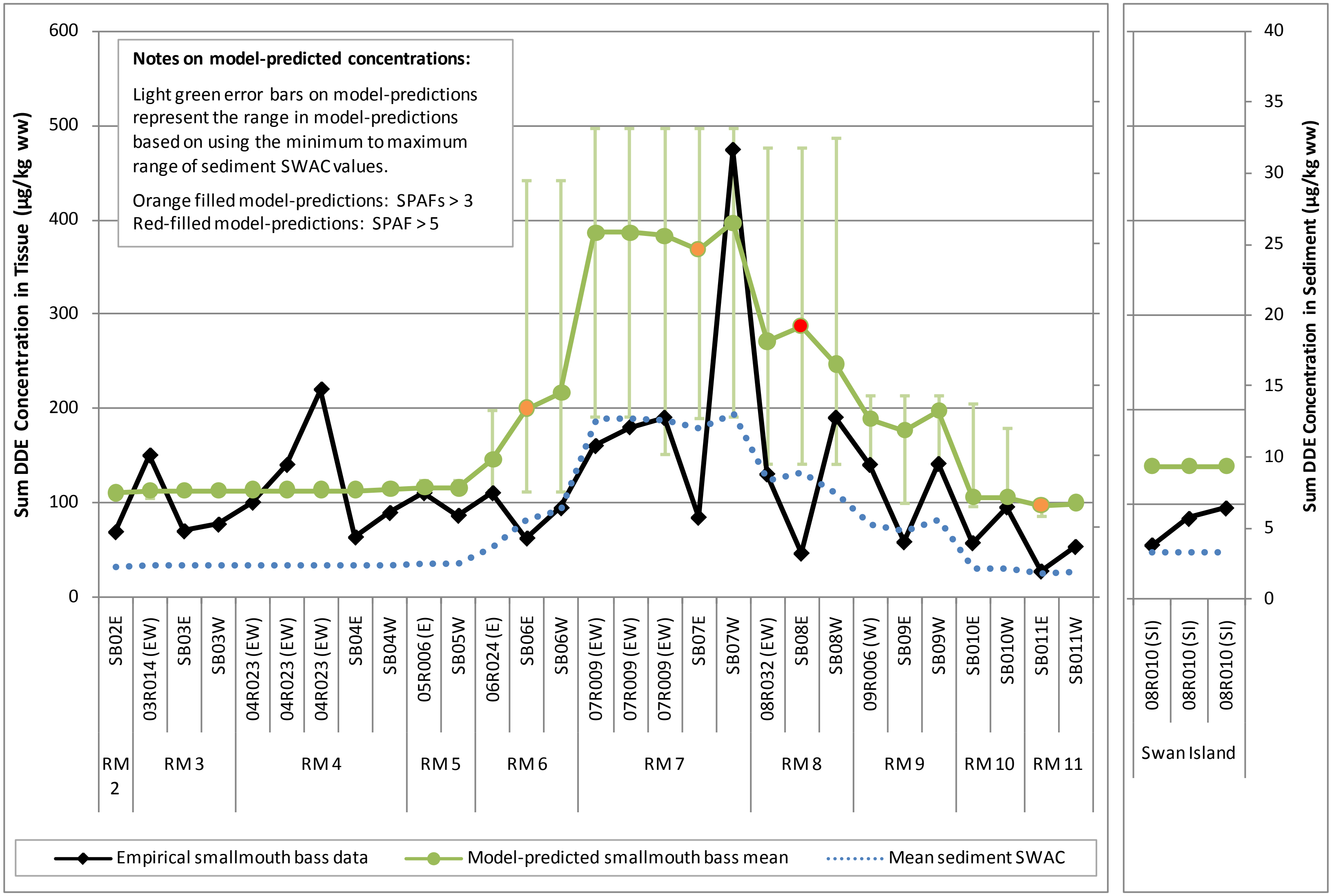

Figure B1-25
Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for Sum DDE for RM 2 through RM 11 and for Swan Island Lagoon

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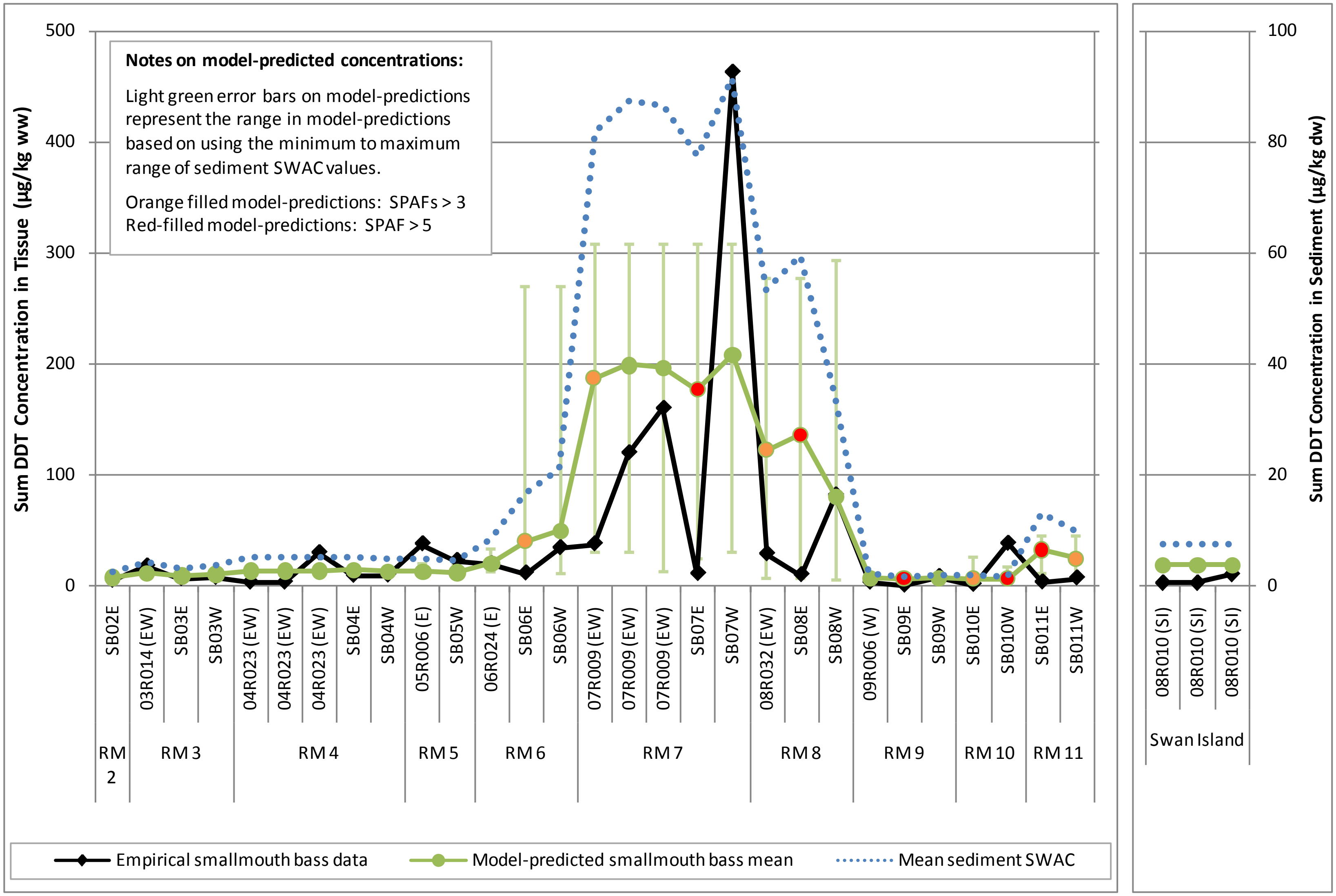

Figure B1-26

Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for Sum DDT for RM 2 through RM 11 and for Swan Island Lagoon

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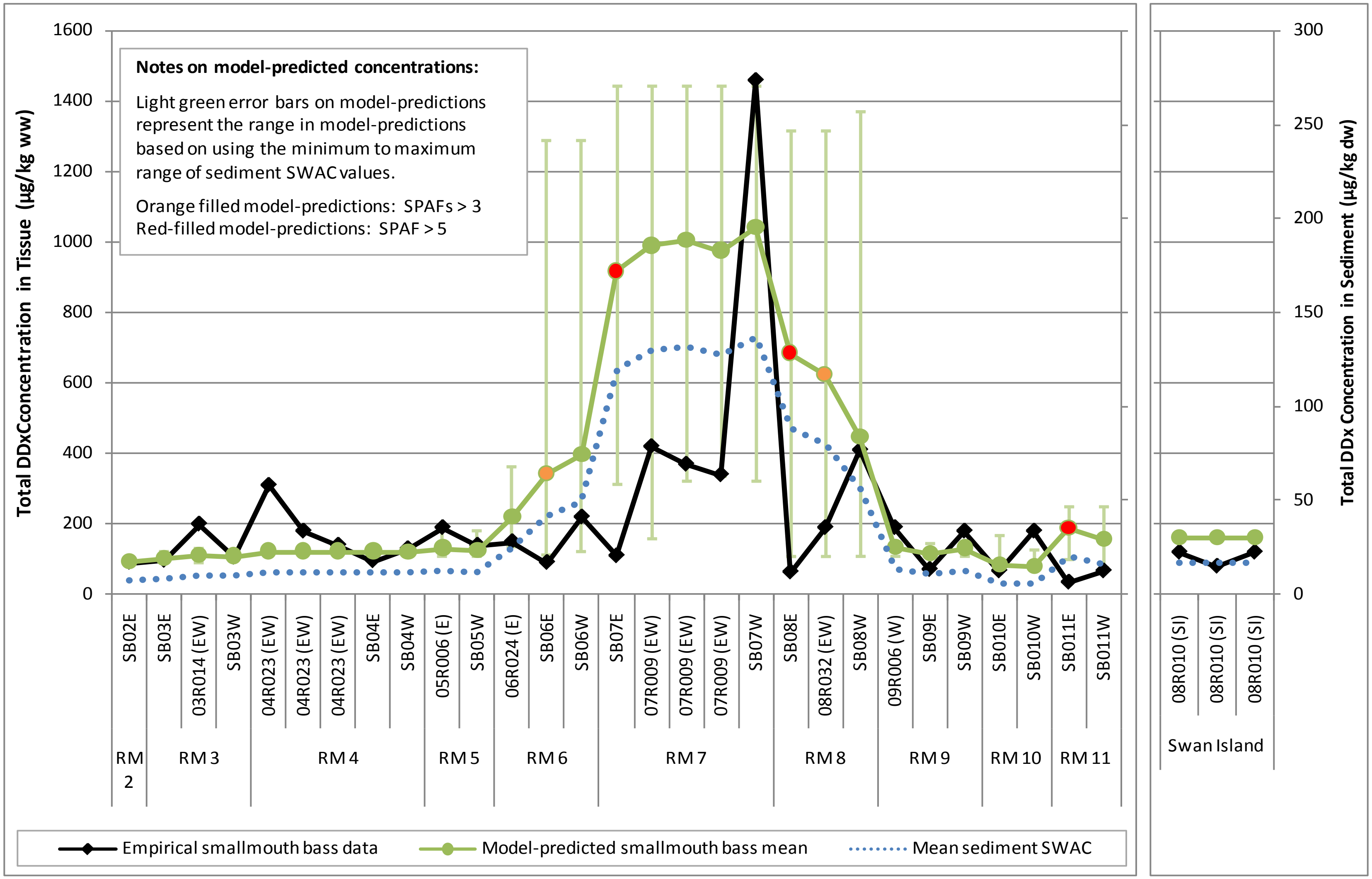

Figure B1-27
Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for DDx for RM 2 through RM 11 and for Swan Island Lagoon

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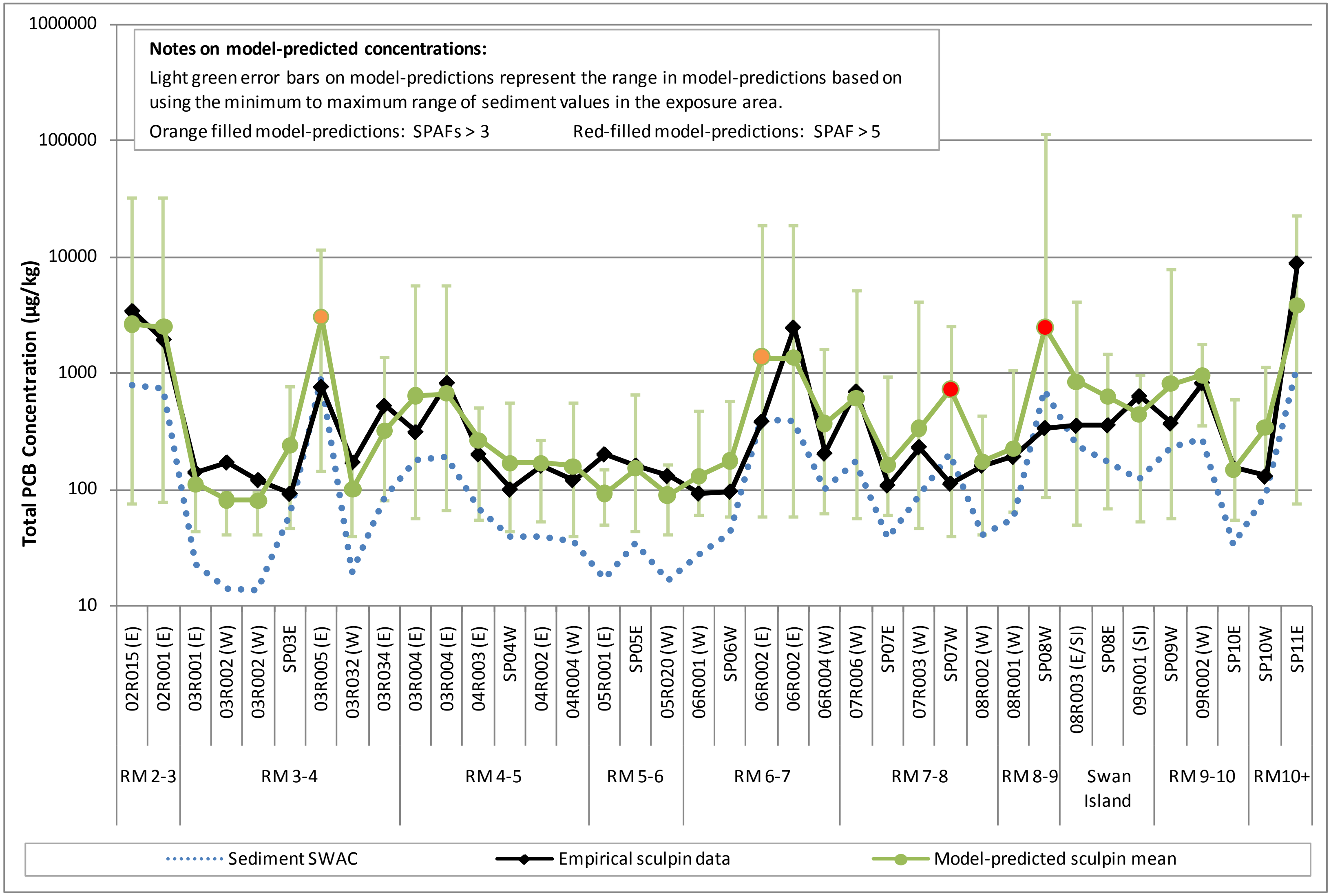

Figure B1-28
Empirical and Model-Predicted Sculpin Tissue Concentrations for Total PCBs for RM 2 through RM 11

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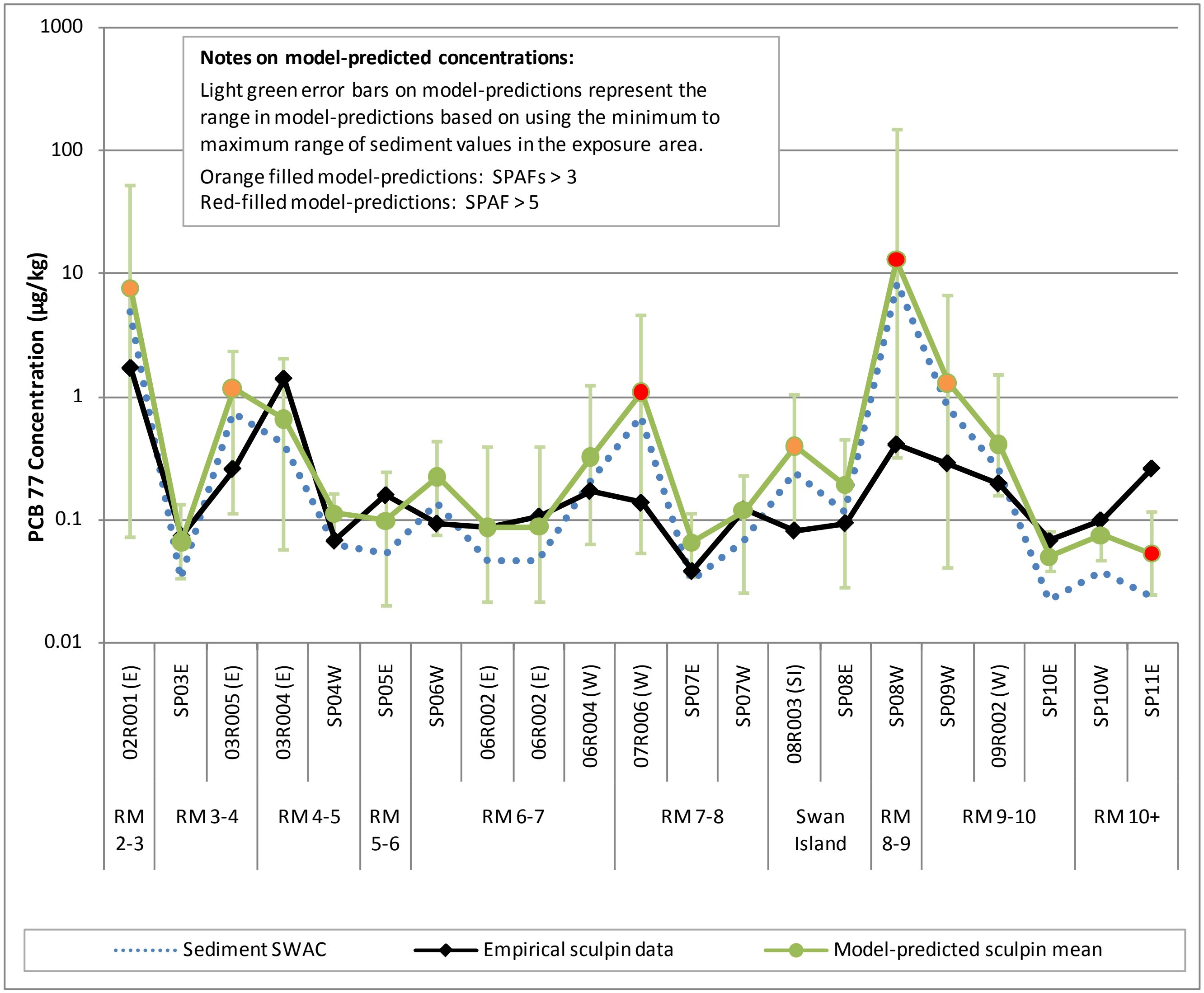

Figure B1-29

Empirical and Model-Predicted Sculpin Tissue Concentrations for PCB 77 for RM 2 through RM 11

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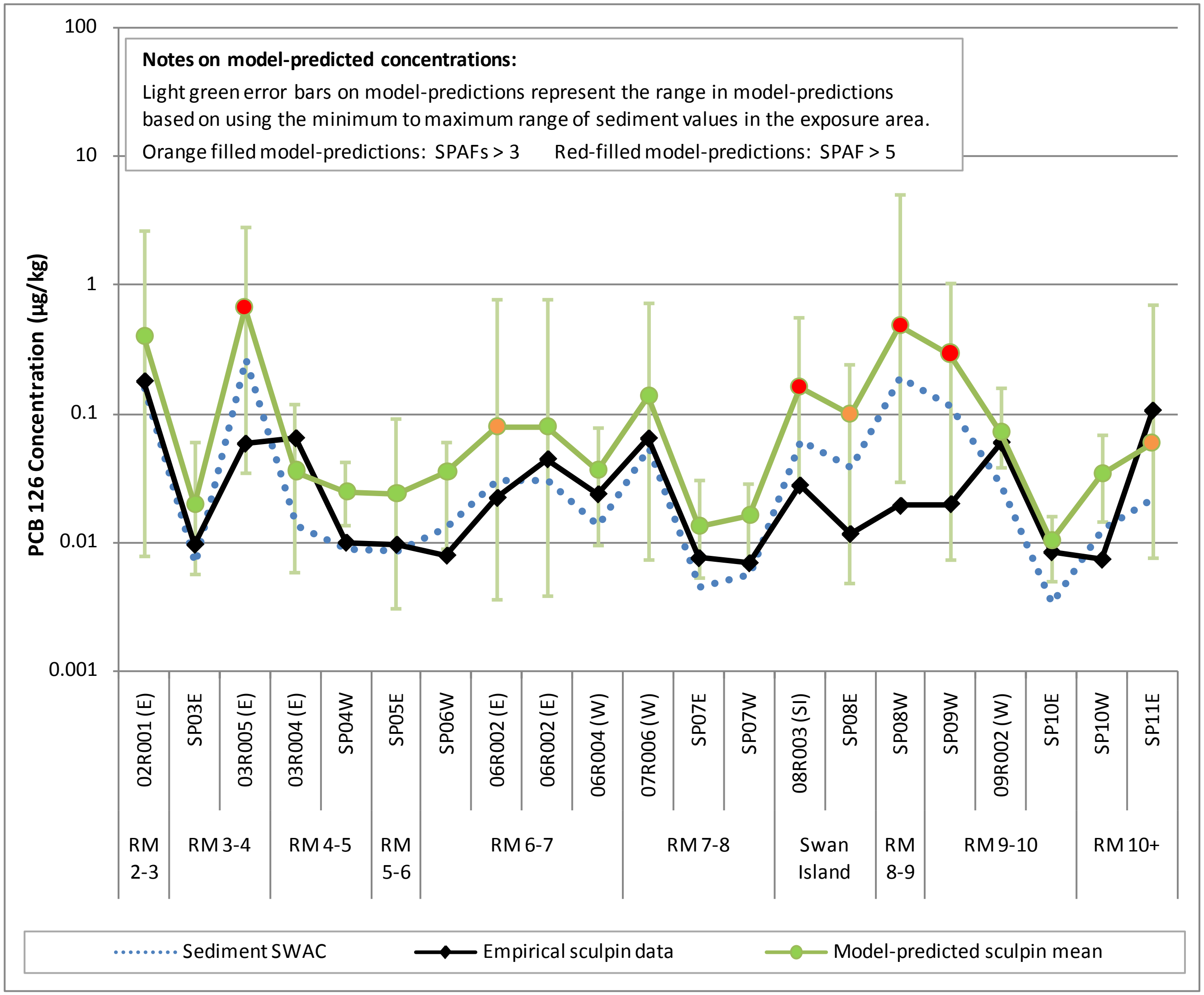

Figure B1-30

Empirical and Model-Predicted Sculpin Tissue Concentrations for PCB 126 for RM 2 through RM 11

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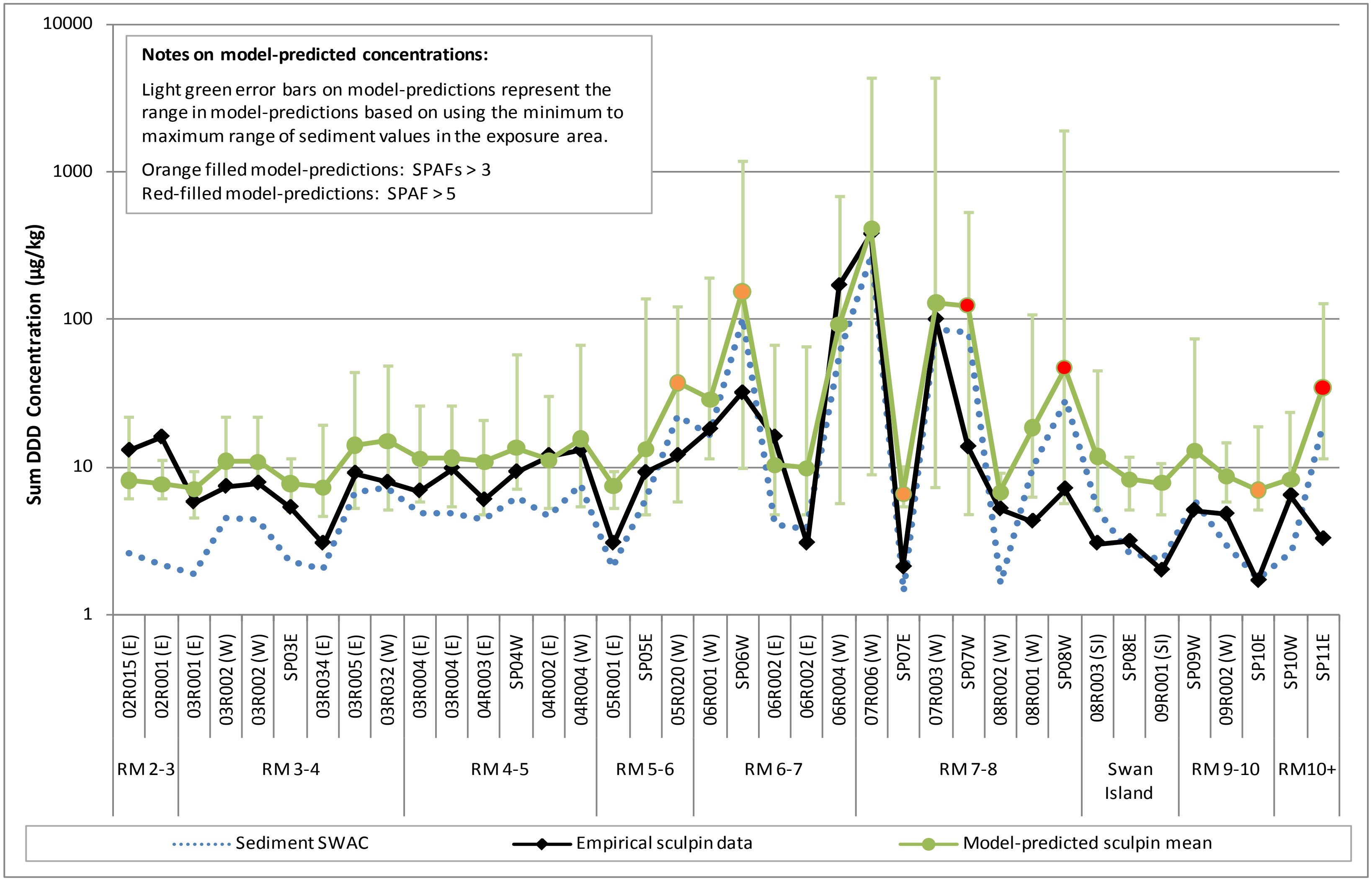

Figure B1-31
Empirical and Model-Predicted Sculpin Tissue Concentrations for Sum DDD for RM 2 through RM 11

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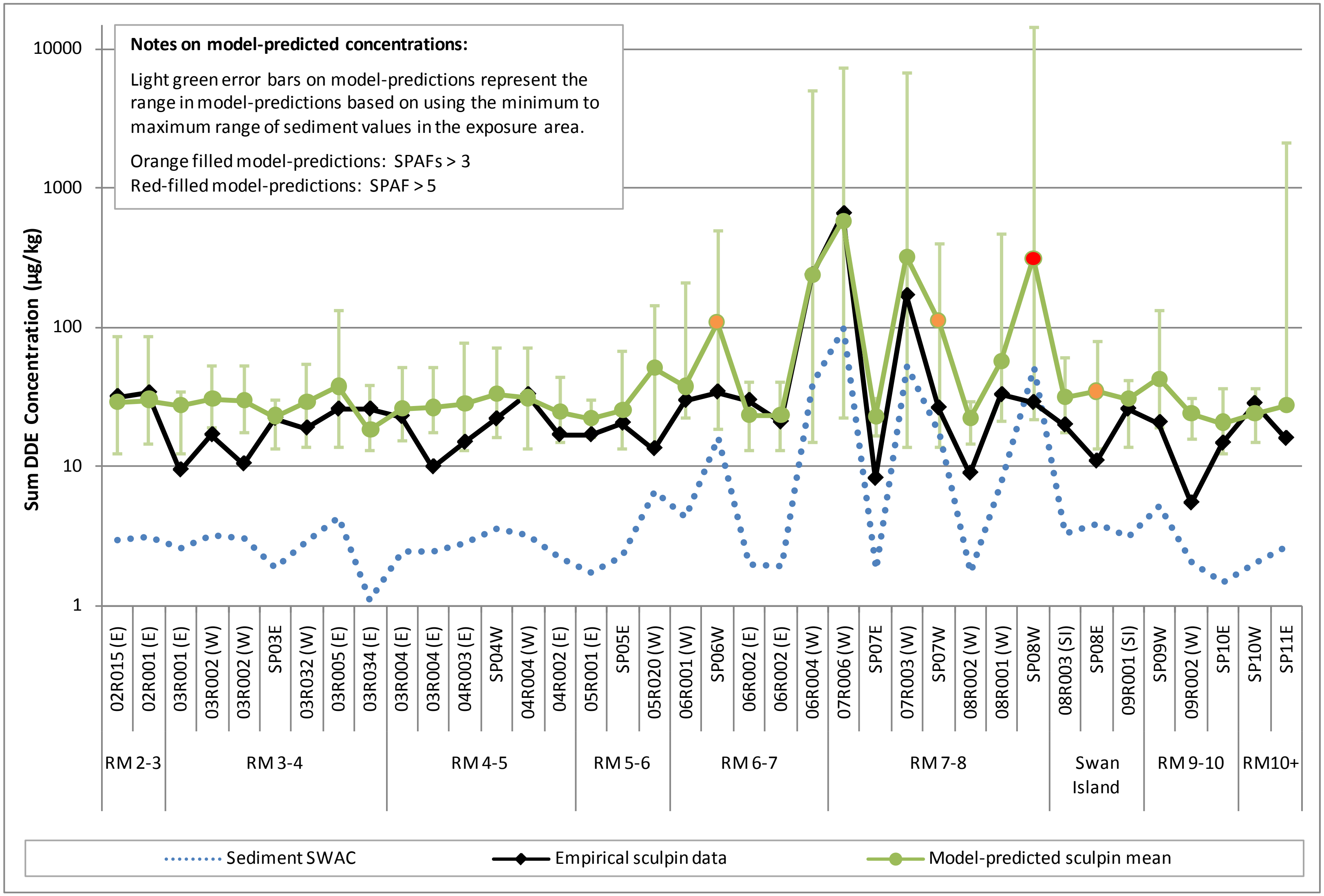

Figure B1-32
Empirical and Model-Predicted Sculpin Tissue Concentrations for Sum DDE for RM 2 through RM 11

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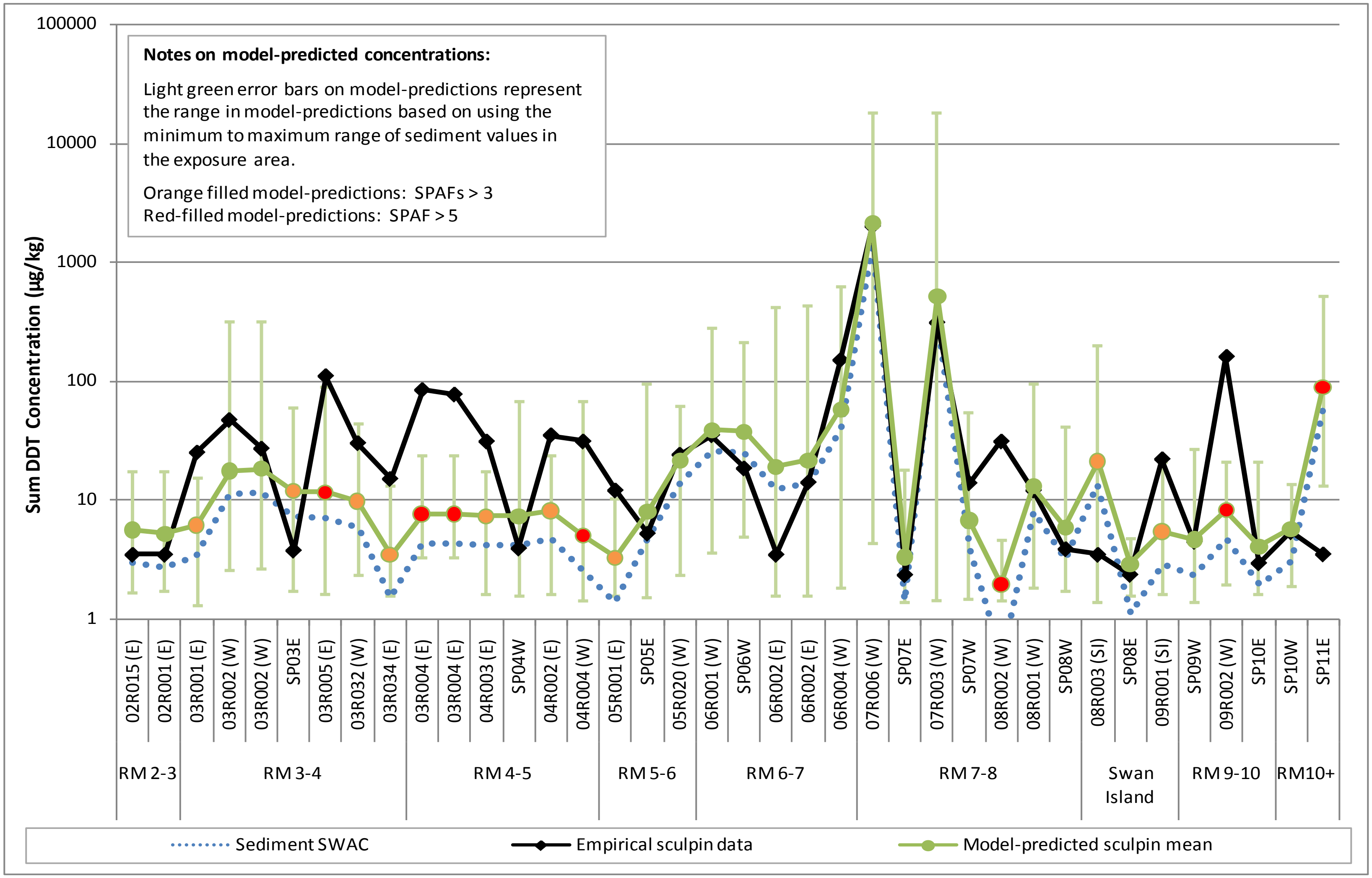

Figure B1-33
Empirical and Model-Predicted Sculpin Tissue Concentrations for Sum DDT for RM 2 through RM 11

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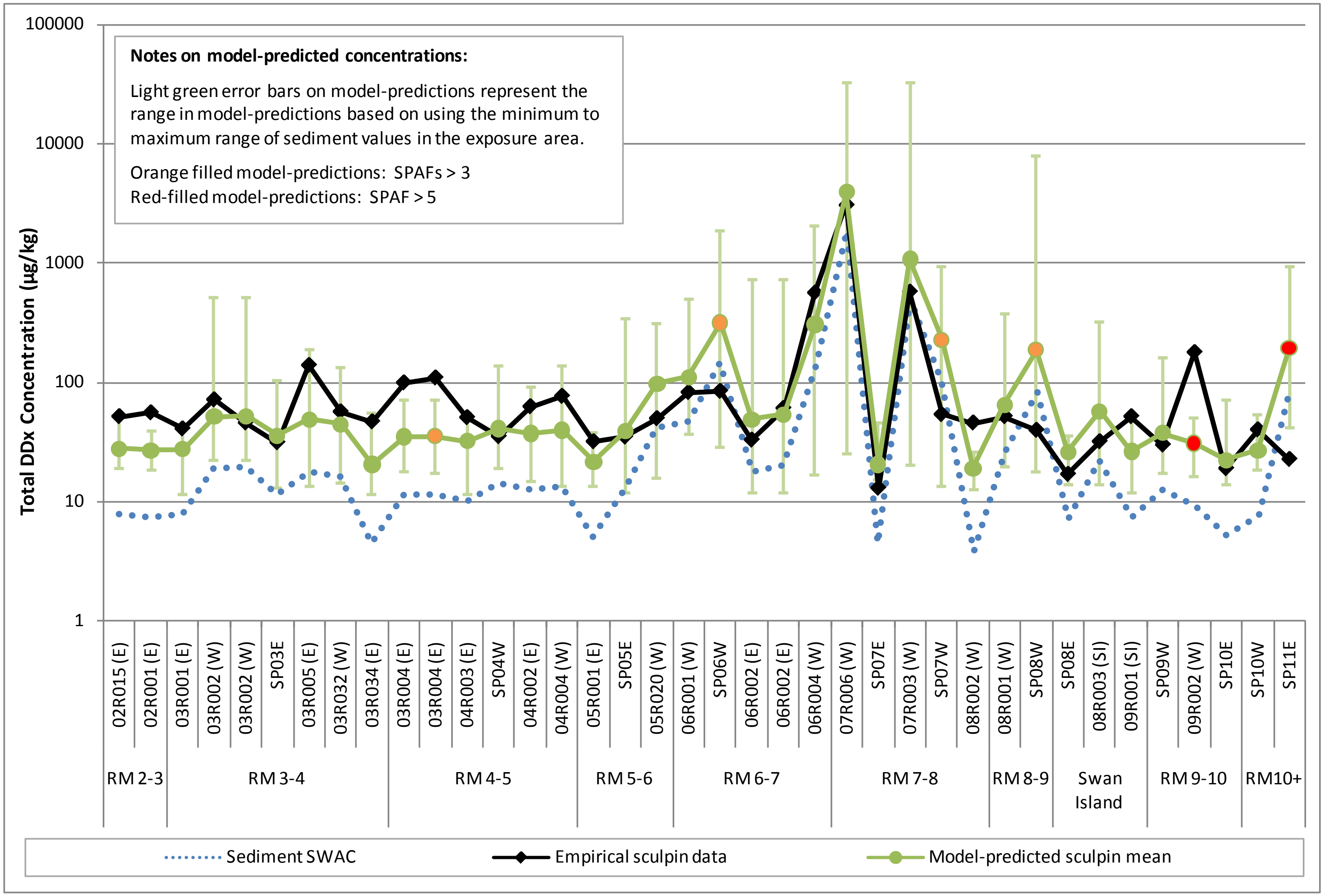

Figure B1-34
Empirical and Model-Predicted Sculpin Tissue Concentrations for DDx for RM 2 through RM 11

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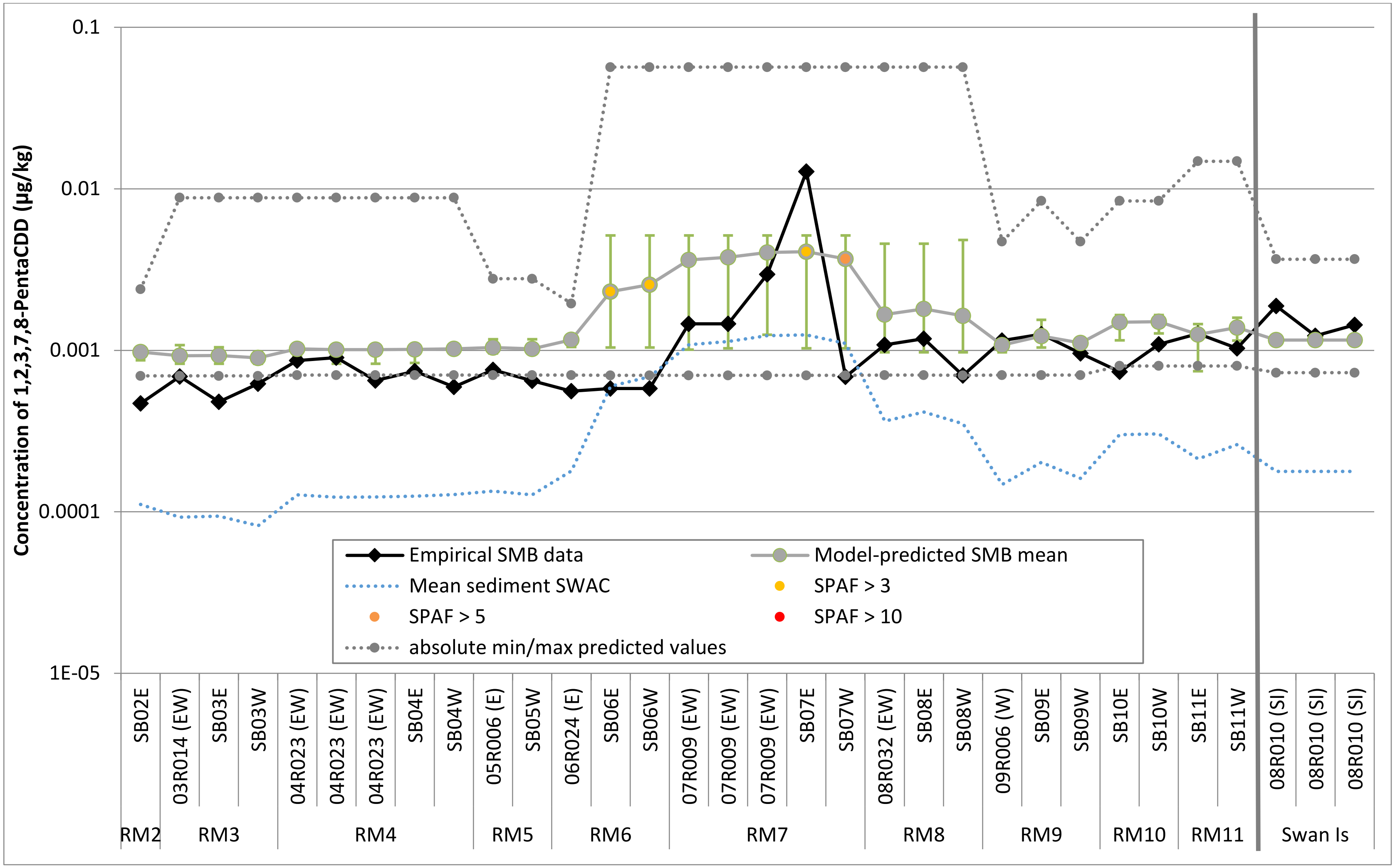

Figure B1-35

Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for 1,2,3,7,8-PentaCDD for RM 2 through RM 11 and for Swan Island Lagoon using Calibration 1

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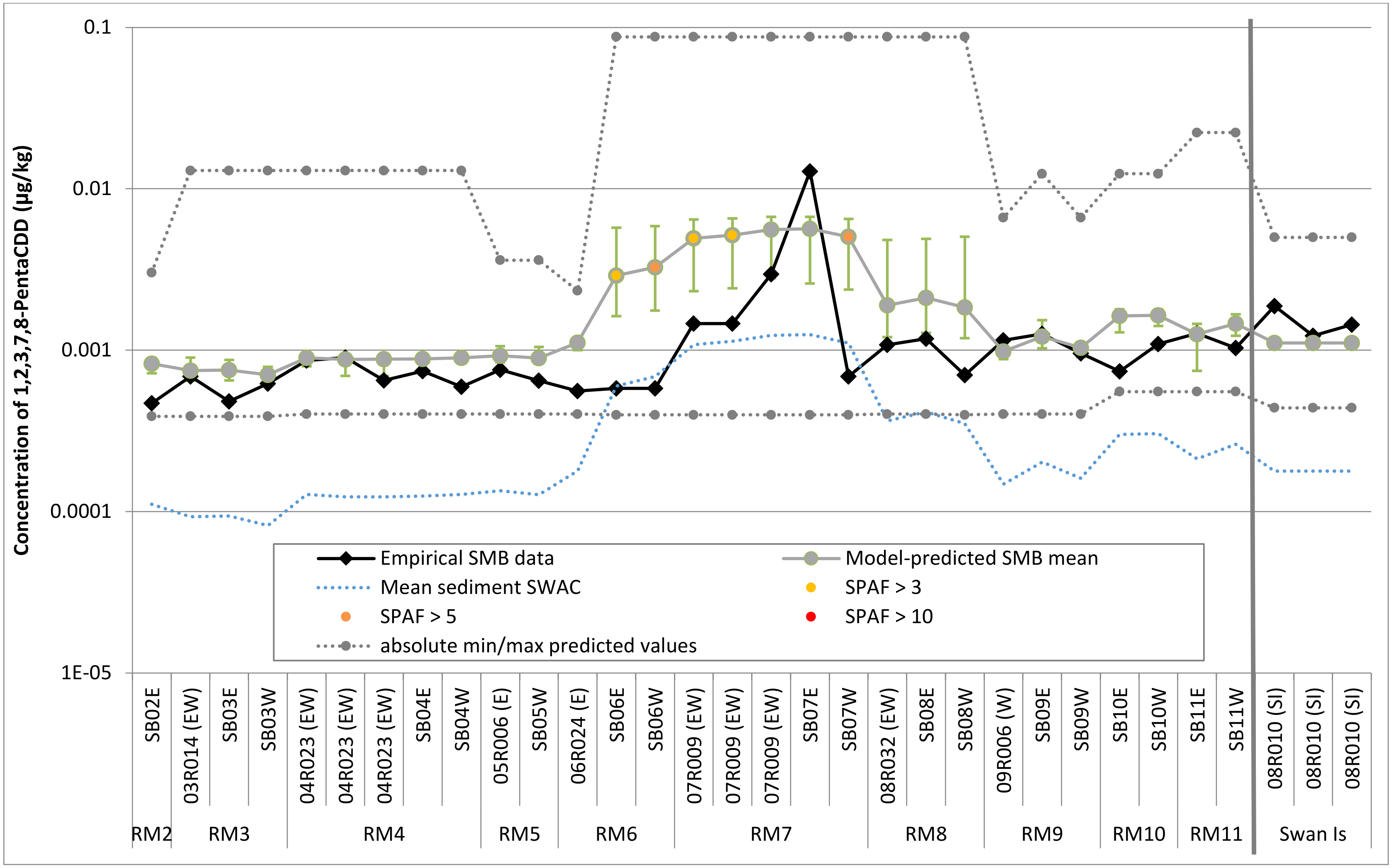

Figure B1-36

Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for 1,2,3,7,8-PentaCDD for RM 2 through RM 11 and for Swan Island Lagoon using Calibration 2

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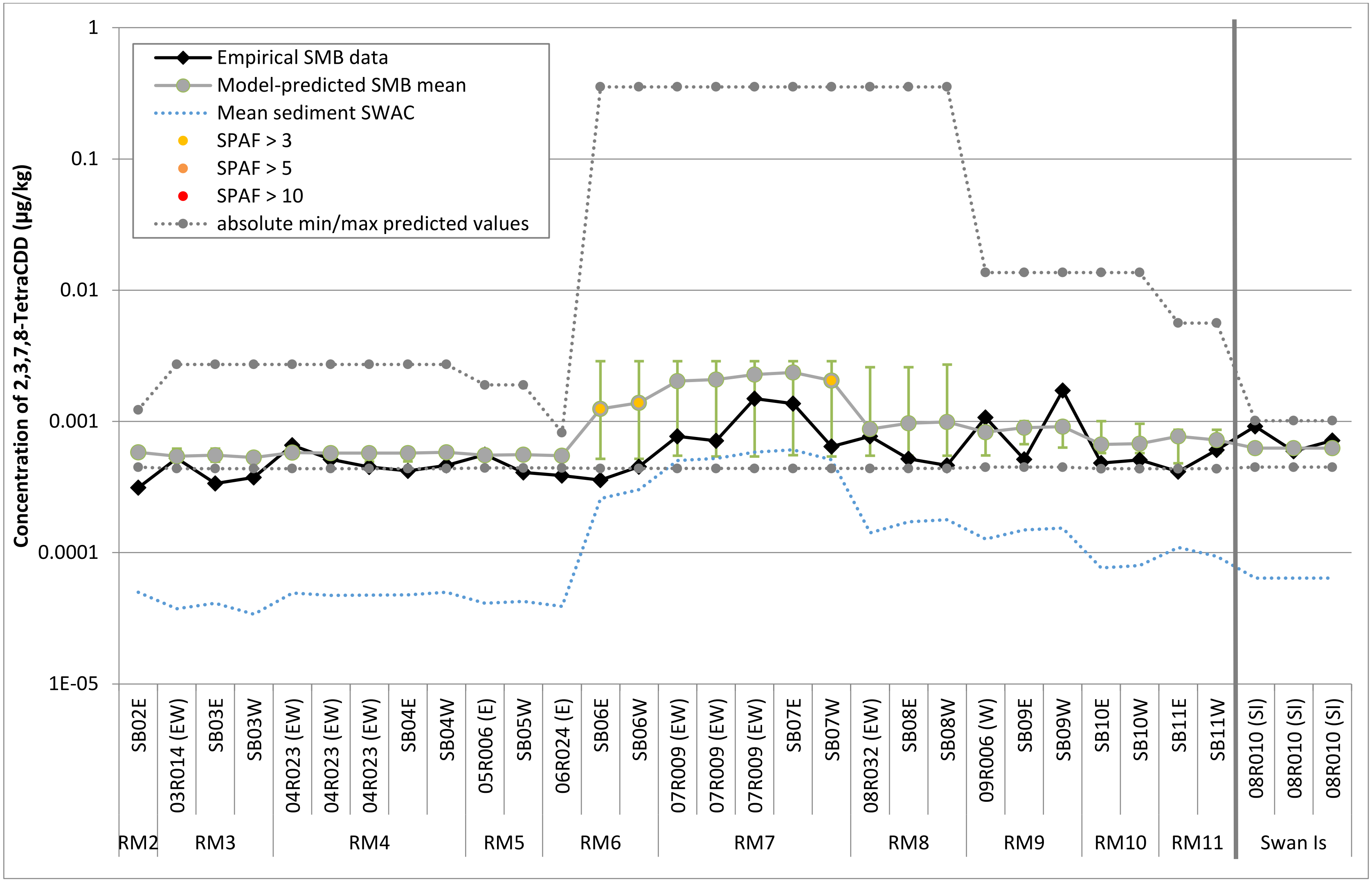

Figure B1-37

Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for 2,3,7,8-TetraCDD for RM 2 through RM 11 and for Swan Island Lagoon using Calibration 1

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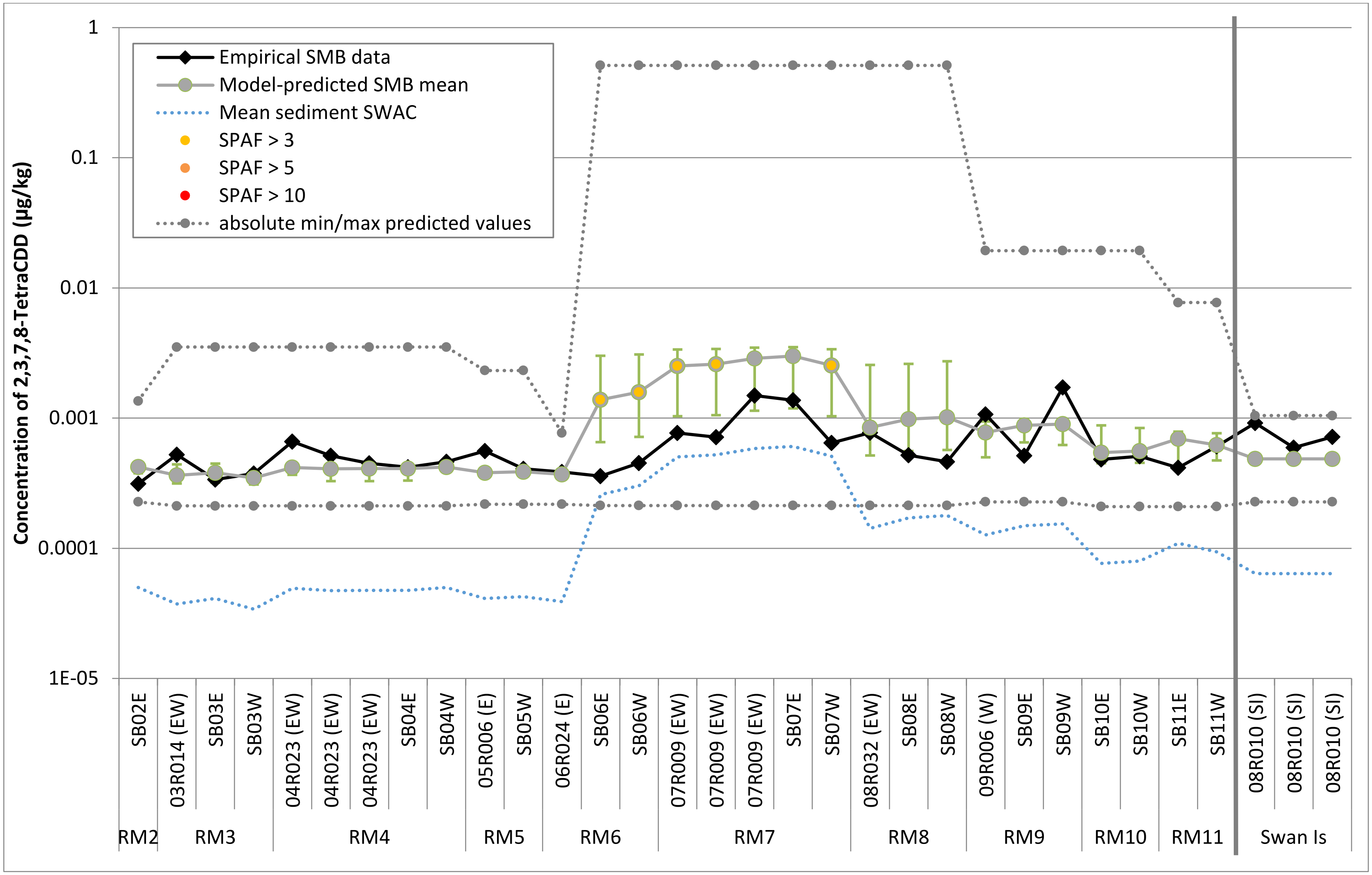

Figure B1-38

Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for 2,3,7,8-TetraCDD for RM 2 through RM 11 and for Swan Island Lagoon using Calibration 2

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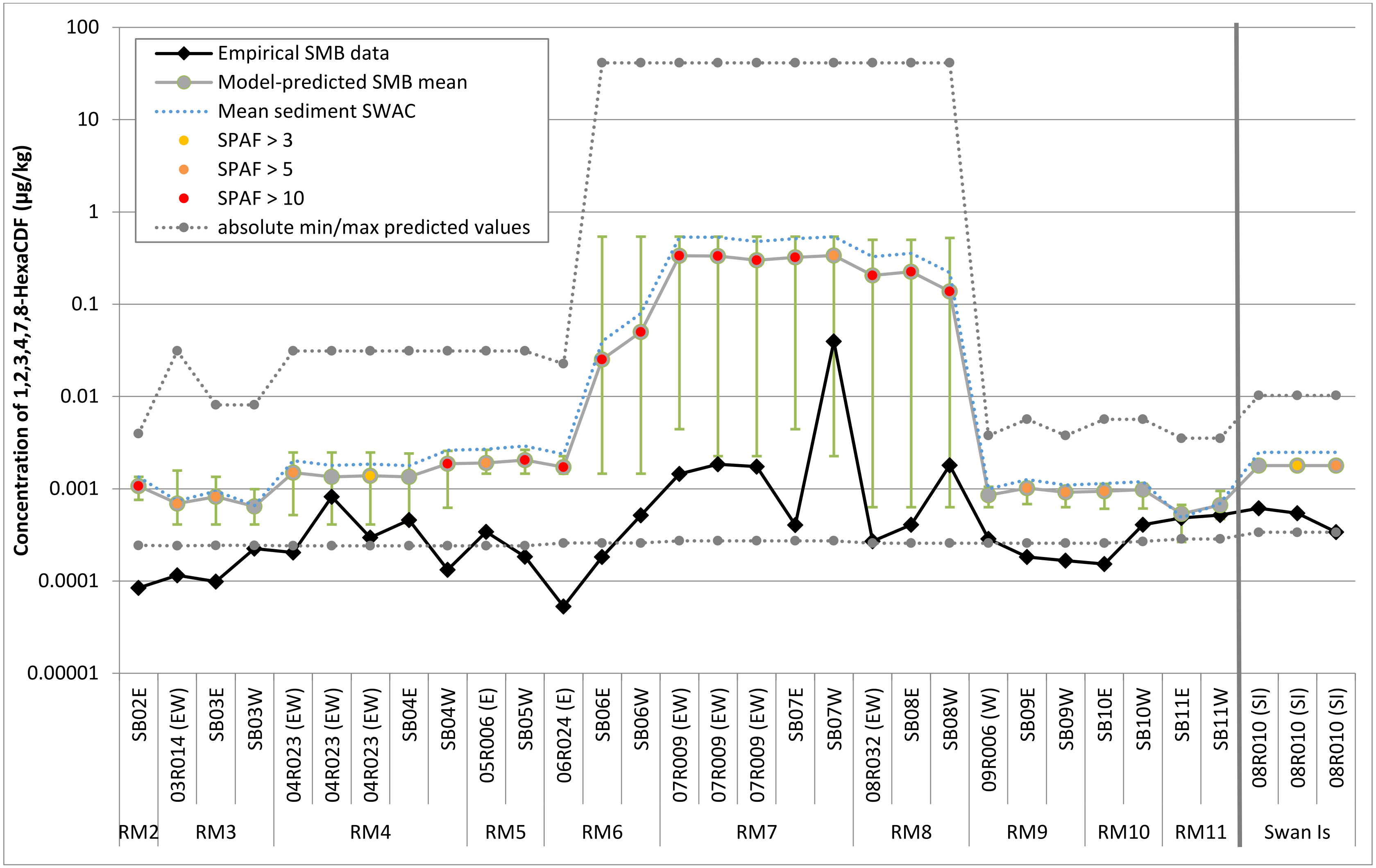

Figure B1-39

Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for 1,2,3,4,7,8-HexaCDF for RM 2 through RM 11 and for Swan Island Lagoon

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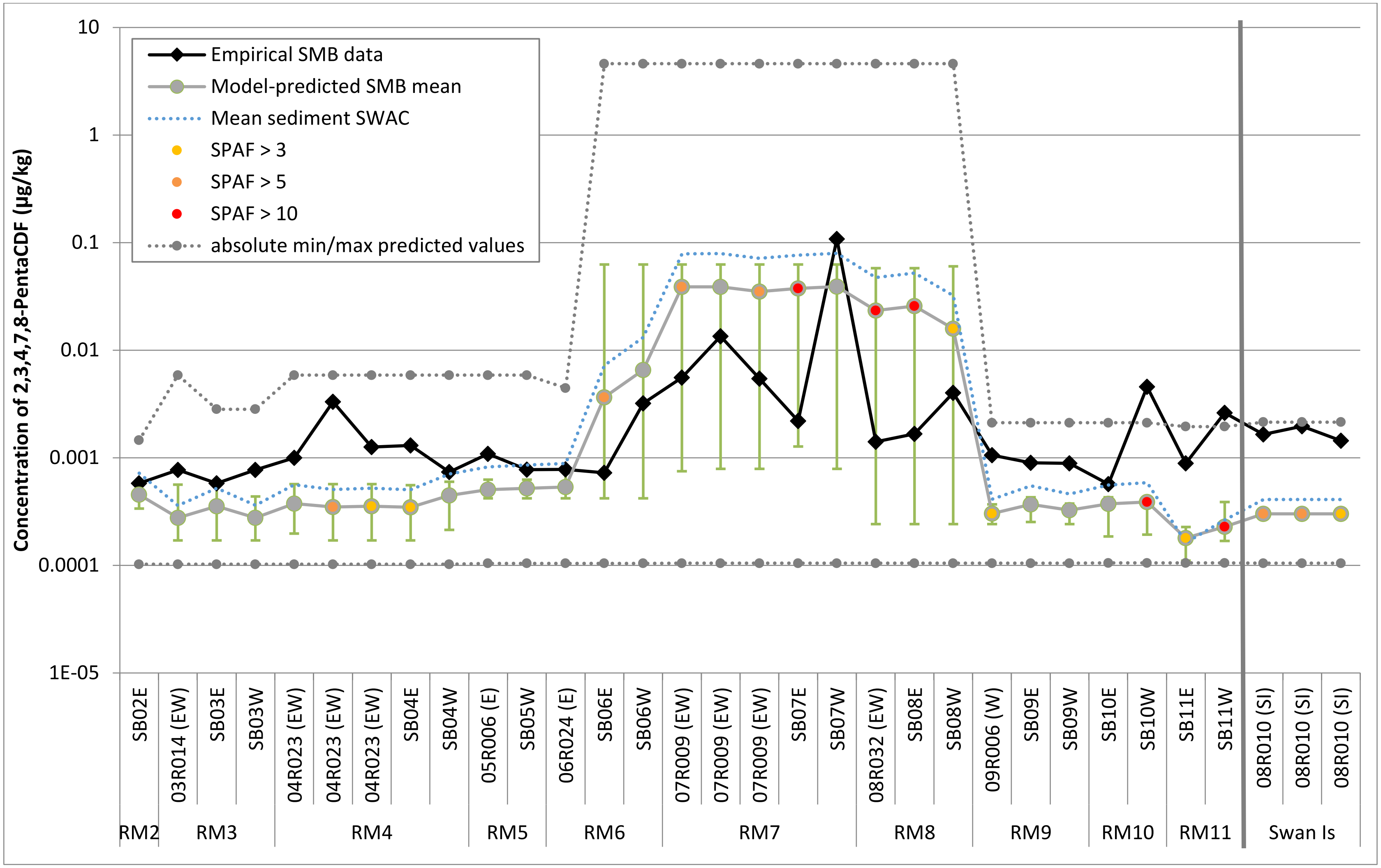

Figure B1-40

Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for 2,3,4,7,8-PentaCDF for RM 2 through RM 11 and for Swan Island Lagoon

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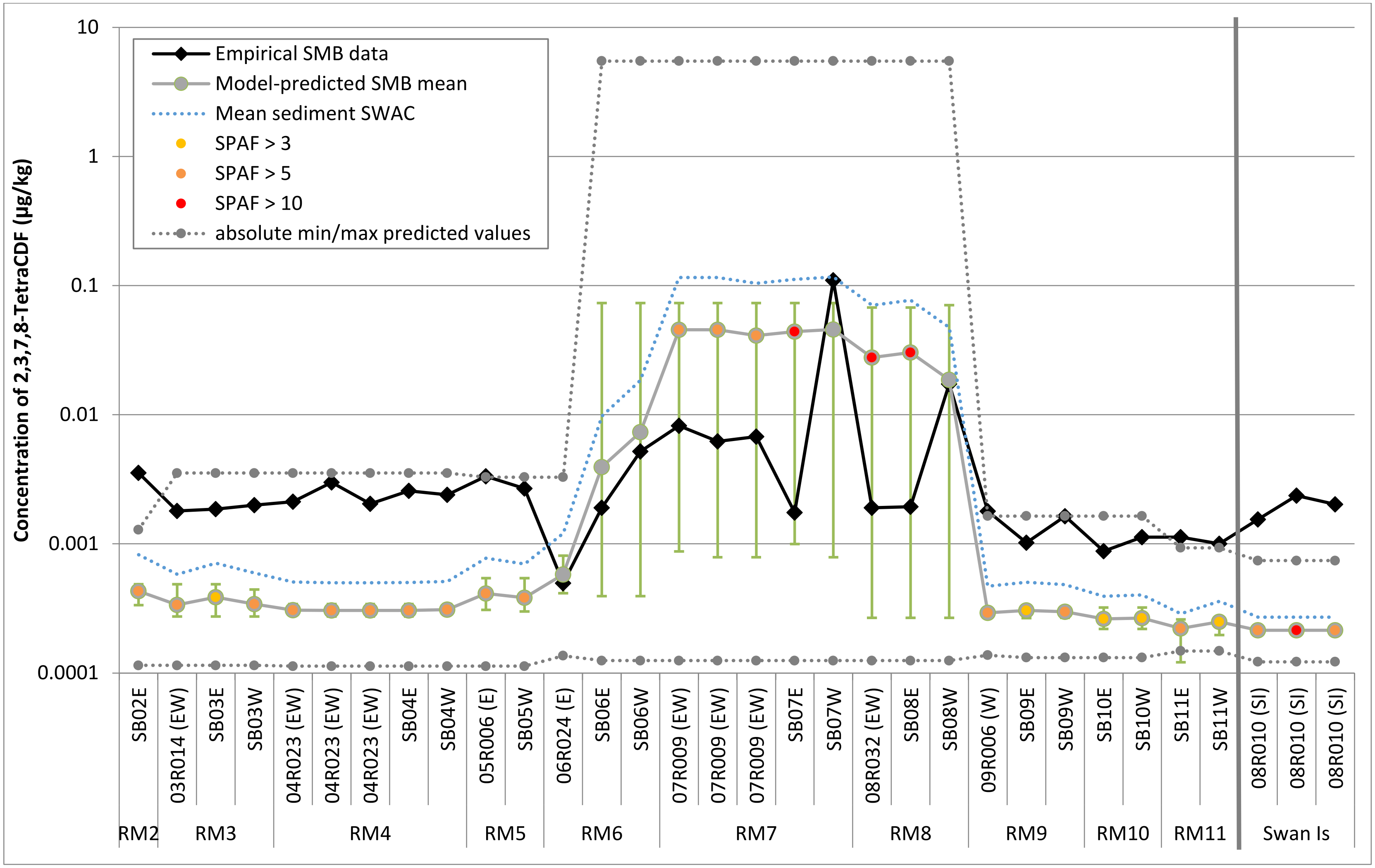

Figure B1-41

Empirical and Model-Predicted Smallmouth Bass Tissue Concentrations for 2,3,7,8-TetraCDF for RM 2 through RM 11 and for Swan Island Lagoon

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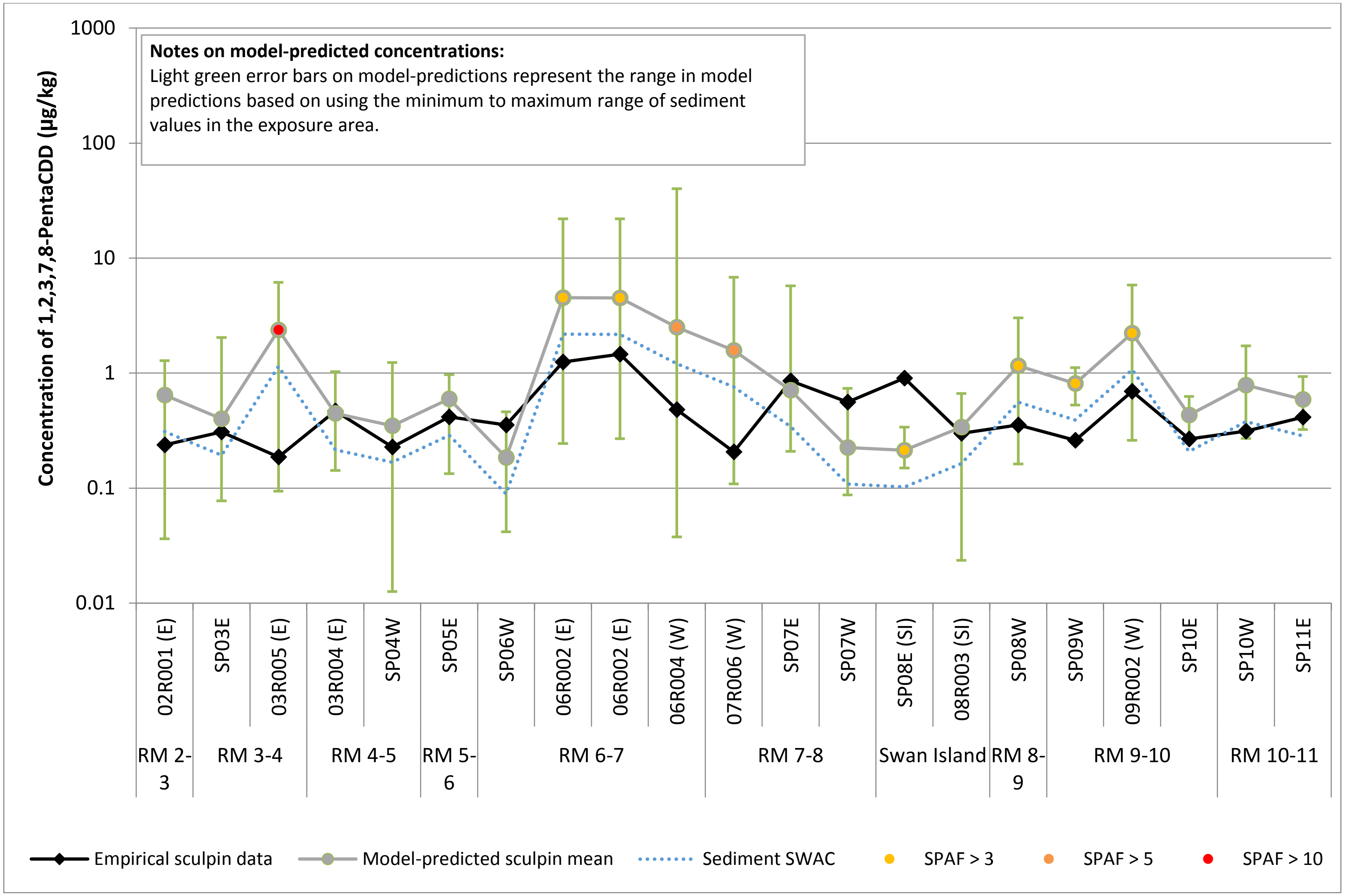

Figure B1-42

Empirical and Model-Predicted Sculpin Tissue Concentrations for 1,2,3,7,8-PentaCDD for RM 2 through RM 11 using Calibration 1

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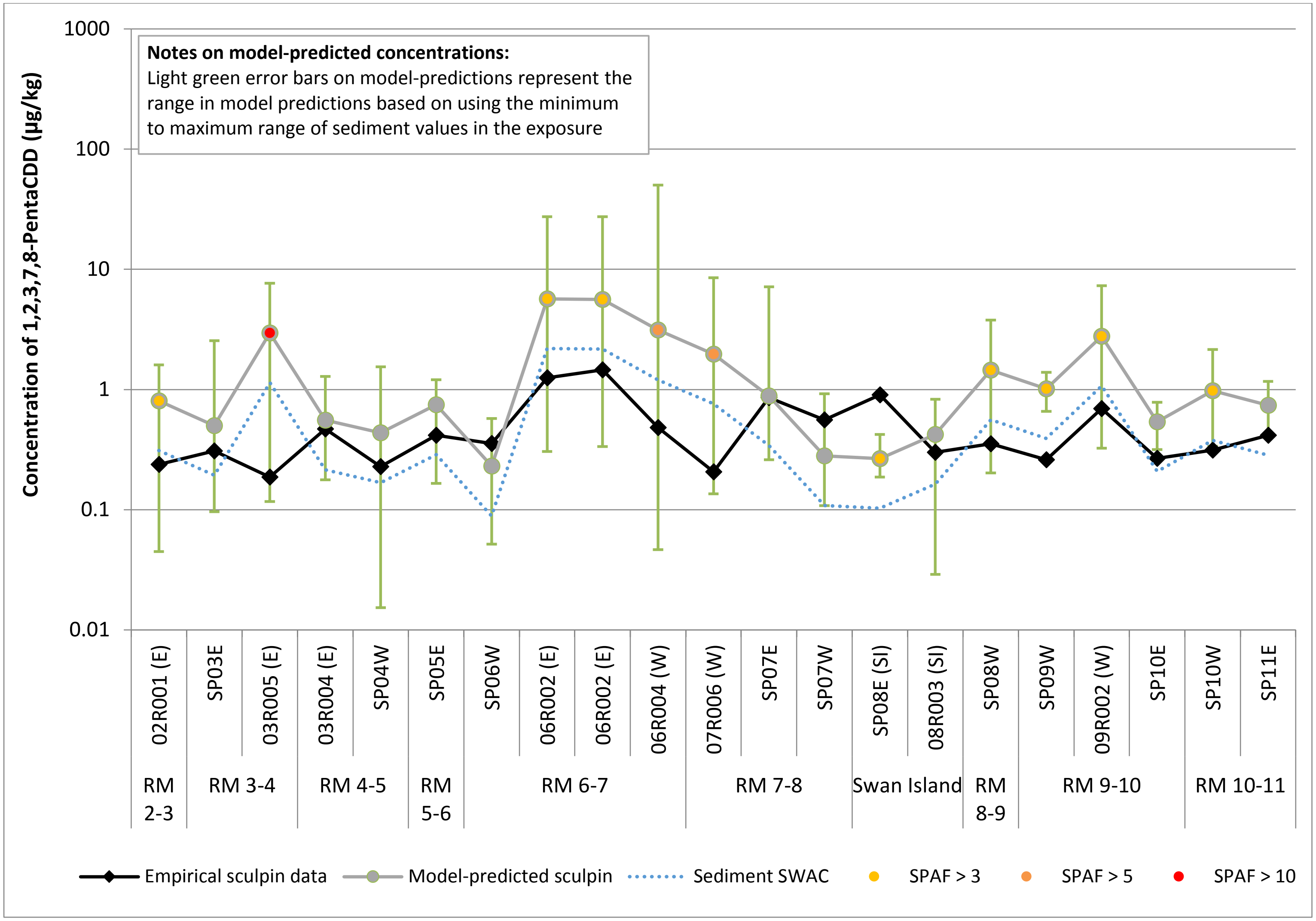

Figure B1-43

Empirical and Model-Predicted Sculpin Tissue Concentrations for 1,2,3,7,8-PentaCDD for RM 2 through RM 11 using Calibration 2

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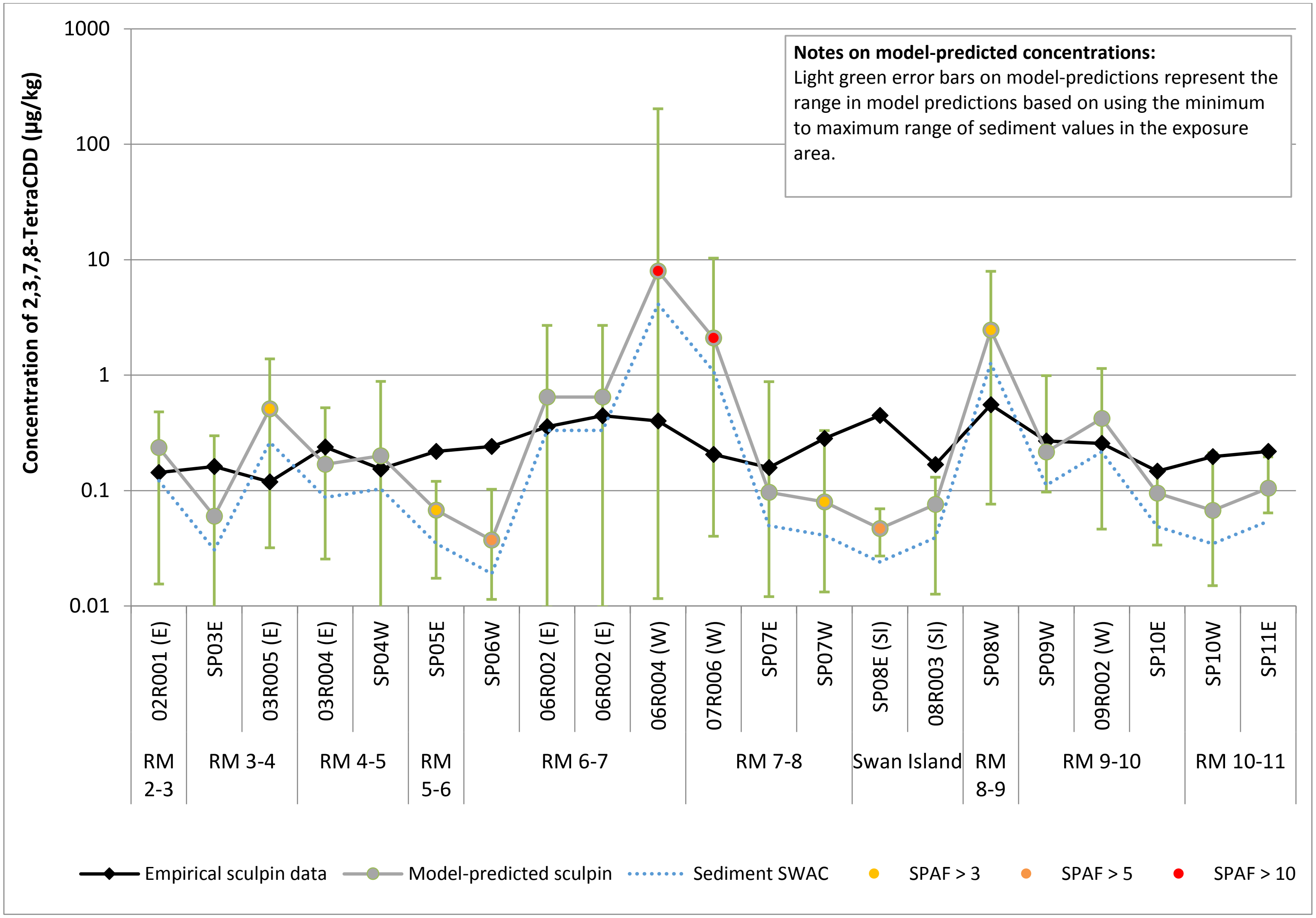

Figure B1-44

Empirical and Model-Predicted Sculpin Tissue Concentrations for 2,3,7,8-TetraCDD for RM 2 through RM 11 using Calibration 1

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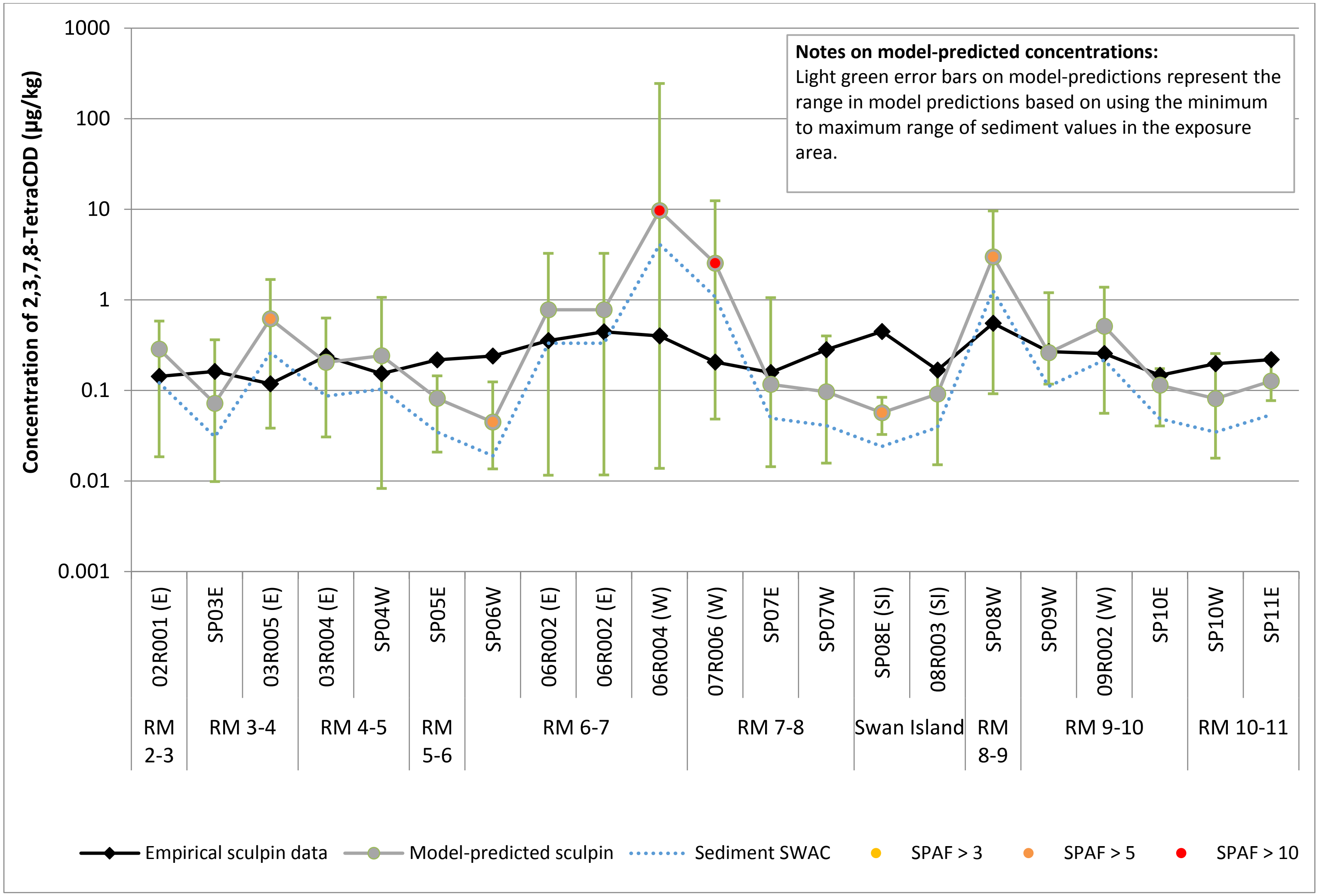

Figure B1-45

Empirical and Model-Predicted Sculpin Tissue Concentrations for 2,3,7,8-TetraCDD for RM 2 through RM 11 using Calibration 2

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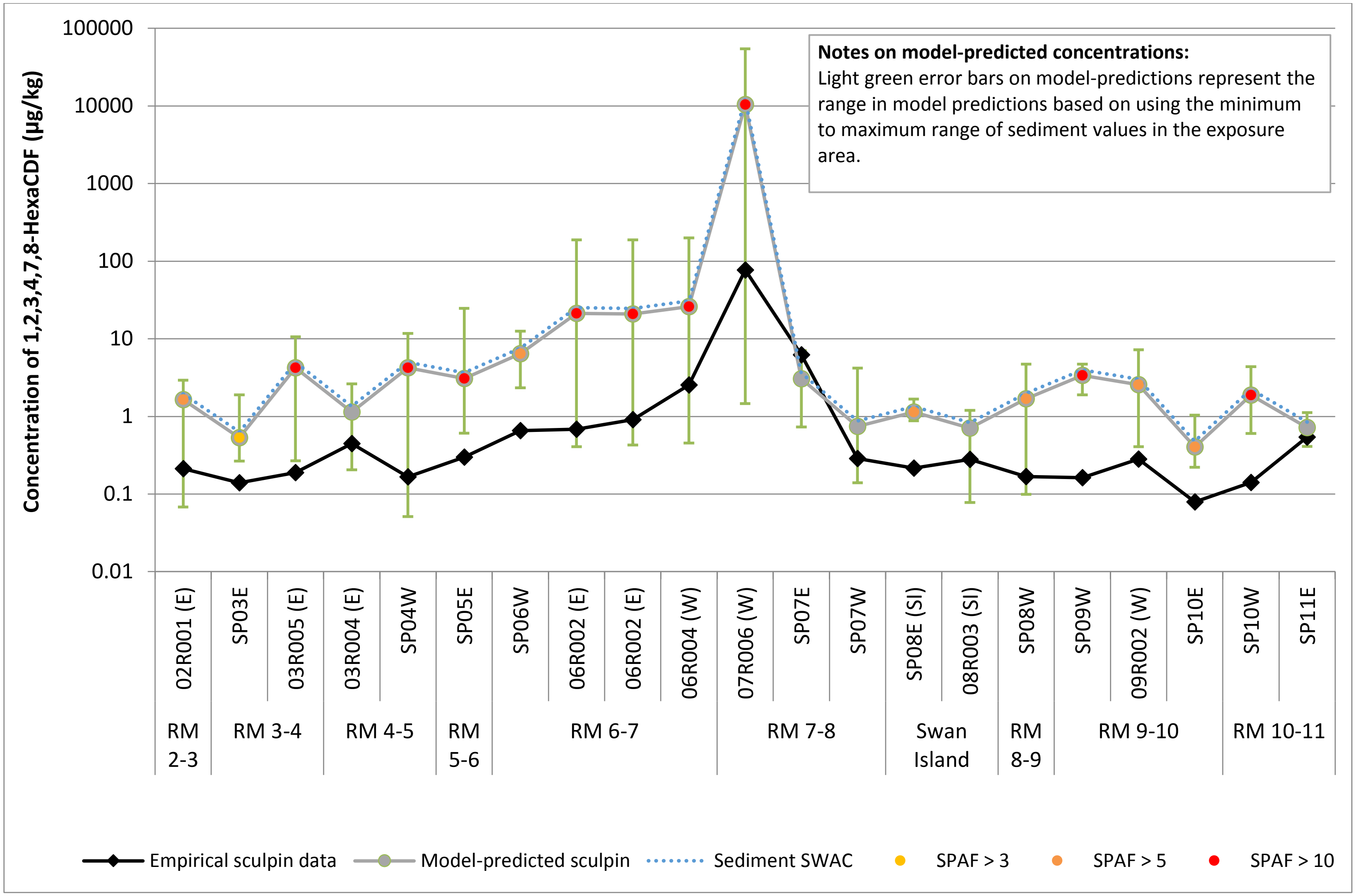

Figure B1-46
Empirical and Model-Predicted Sculpin Tissue Concentrations for 1,2,3,4,7,8-HexaCDF for RM 2 through RM 11

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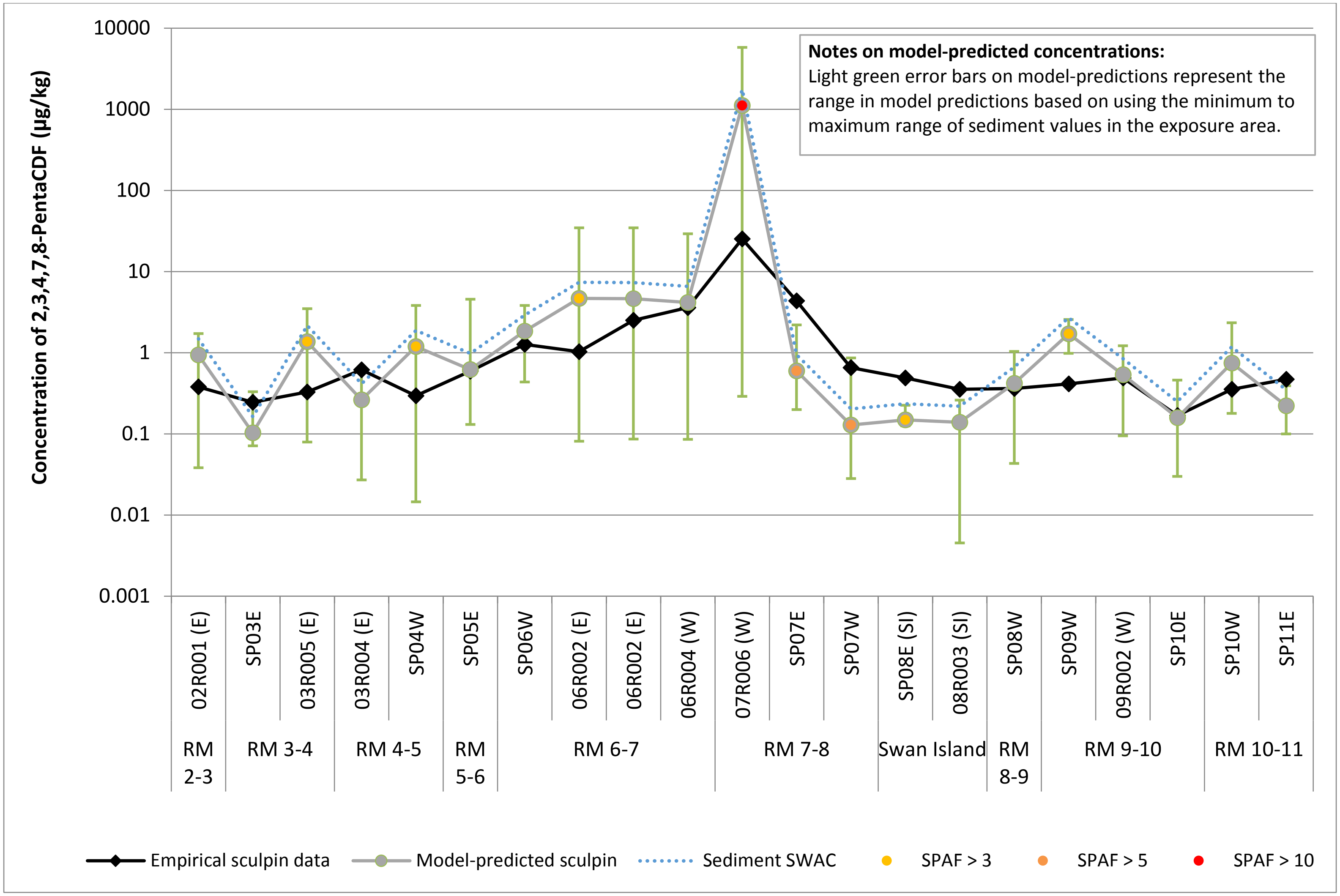

Figure B1-47

Empirical and Model-Predicted Sculpin Tissue Concentrations for 2,3,4,7,8-PentaCDF for RM 2 through RM 11

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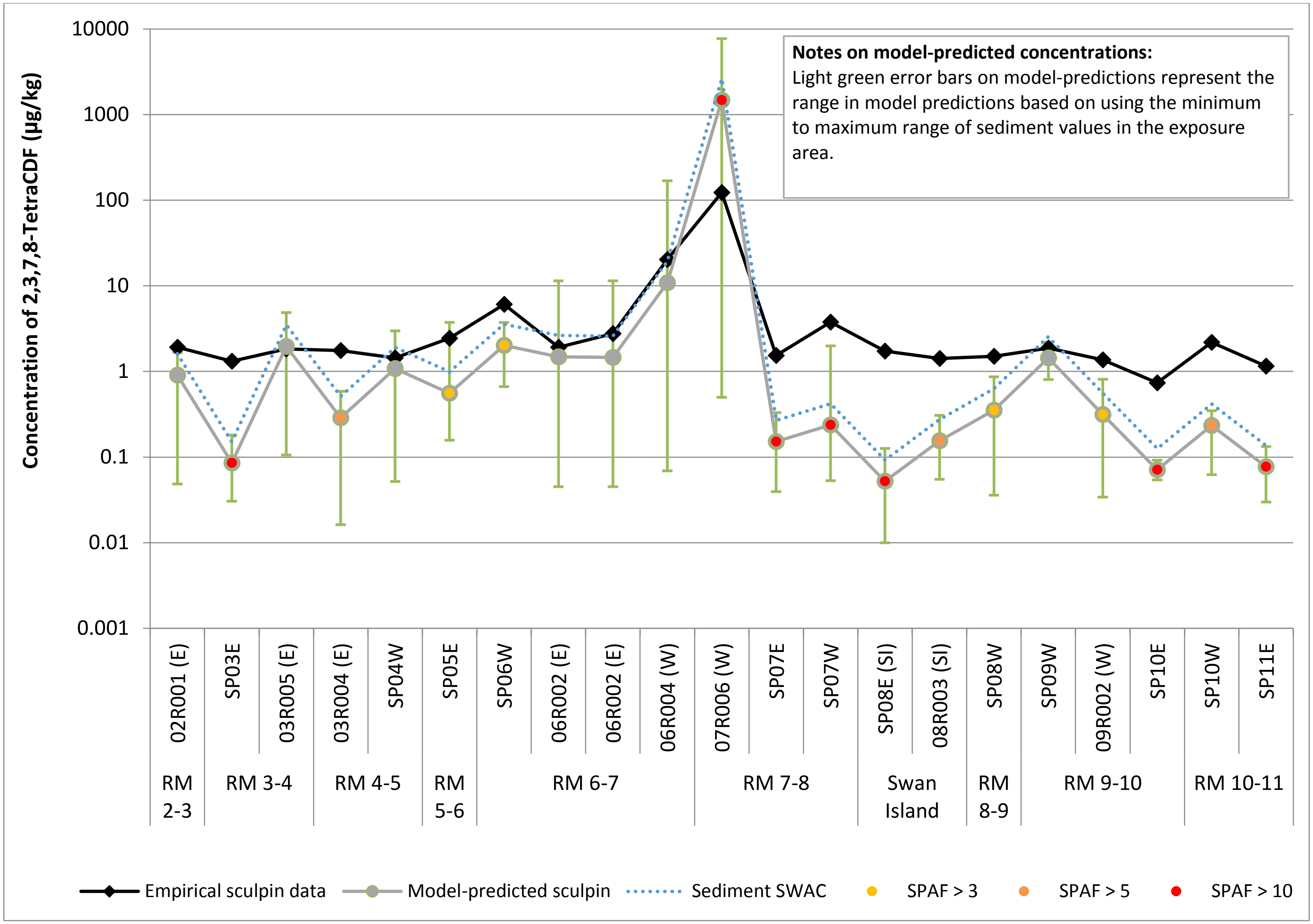

Figure B1-48

Empirical and Model-Predicted Sculpin Tissue Concentrations for 2,3,7,8-TetraCDF for RM 2 through RM 11

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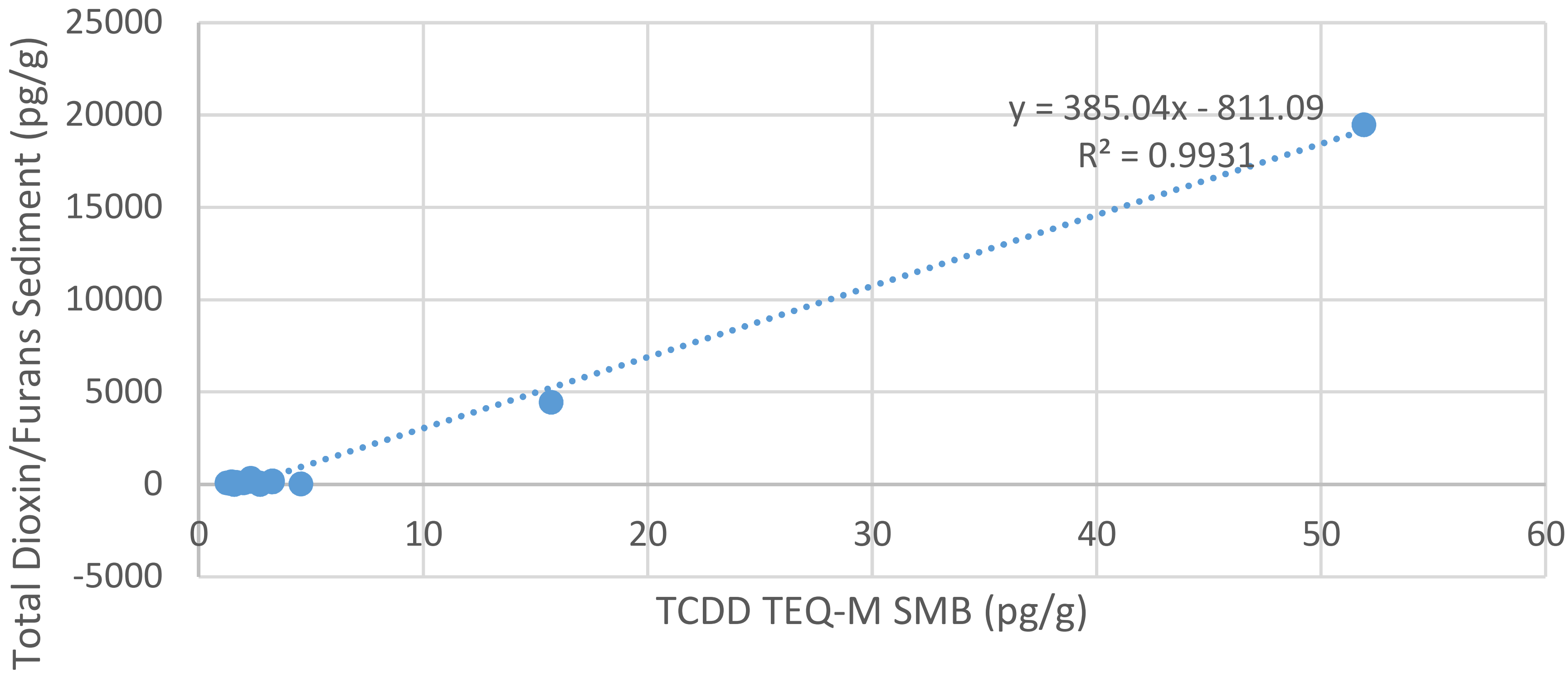

Figure B2-1. TCDD TEQ‐M SMB Tissue vs Total Dioxins/Furans Sediment

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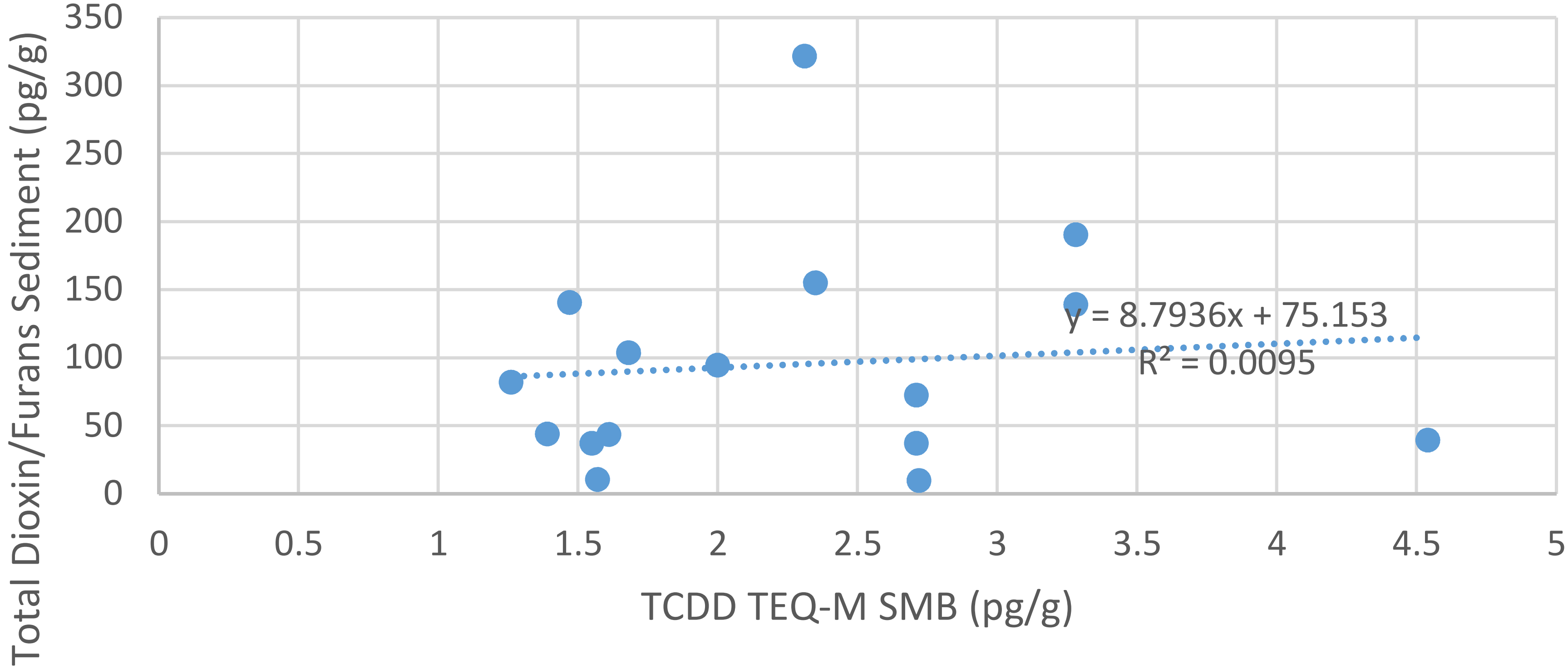

Figure B2-2. TCDD TEQ ‑ M SMB Tissue vs Total Dioxins/Furans Sediment

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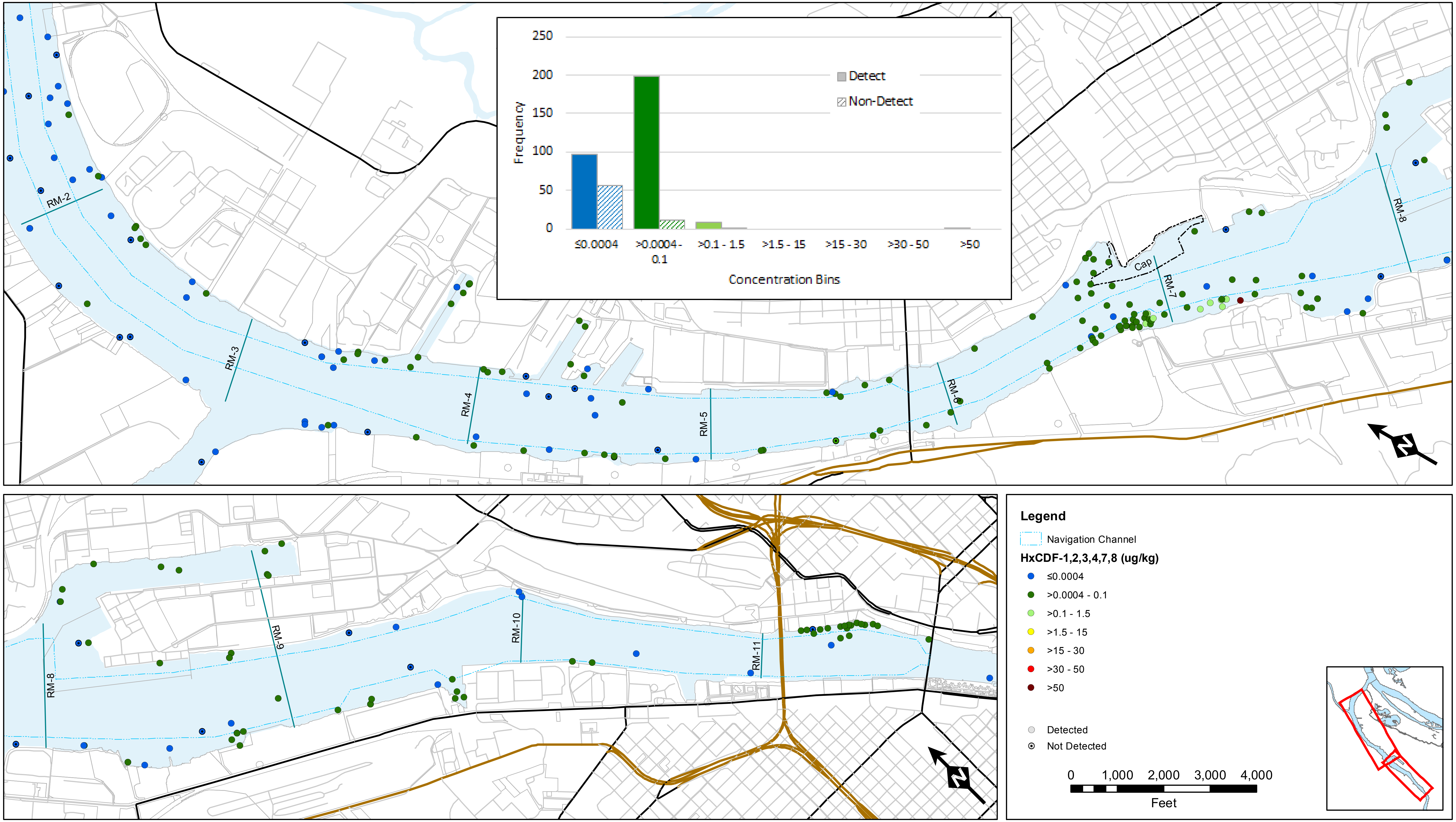

Figure B2-3a. Distribution of Surface Sediment Chemistry for 1,2,3,4,7,8-Hexachlorodibenzofuran

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Date: 4/19/2016

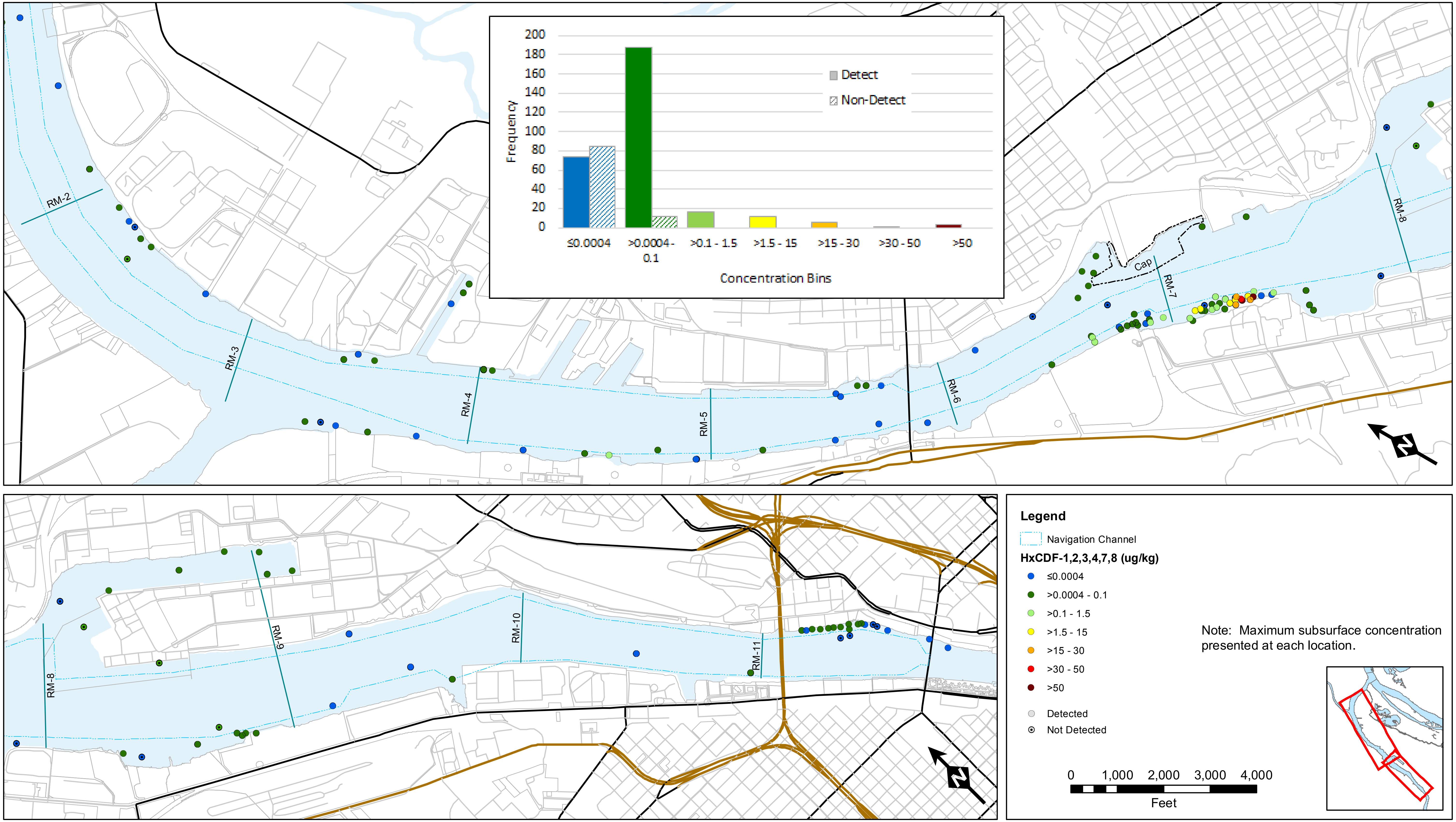

Figure B2-3b. Distribution of Subsurface Sediment Chemistry for 1,2,3,4,7,8-Hexachlorodibenzofuran

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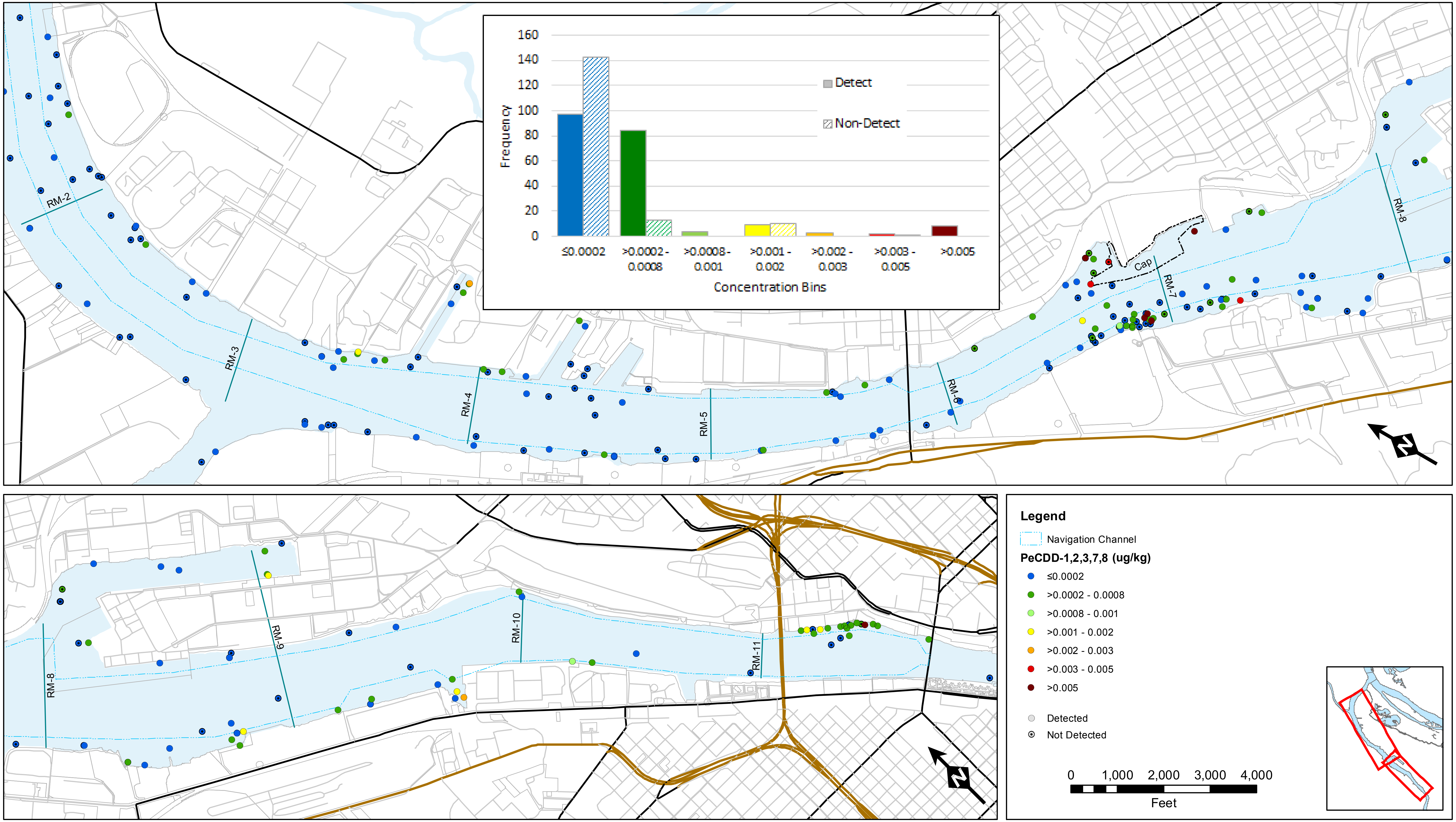

Figure B2-4a. Distribution of Surface Sediment Chemistry for 1,2,3,7,8-Pentachlorodibenzo-p-dioxin

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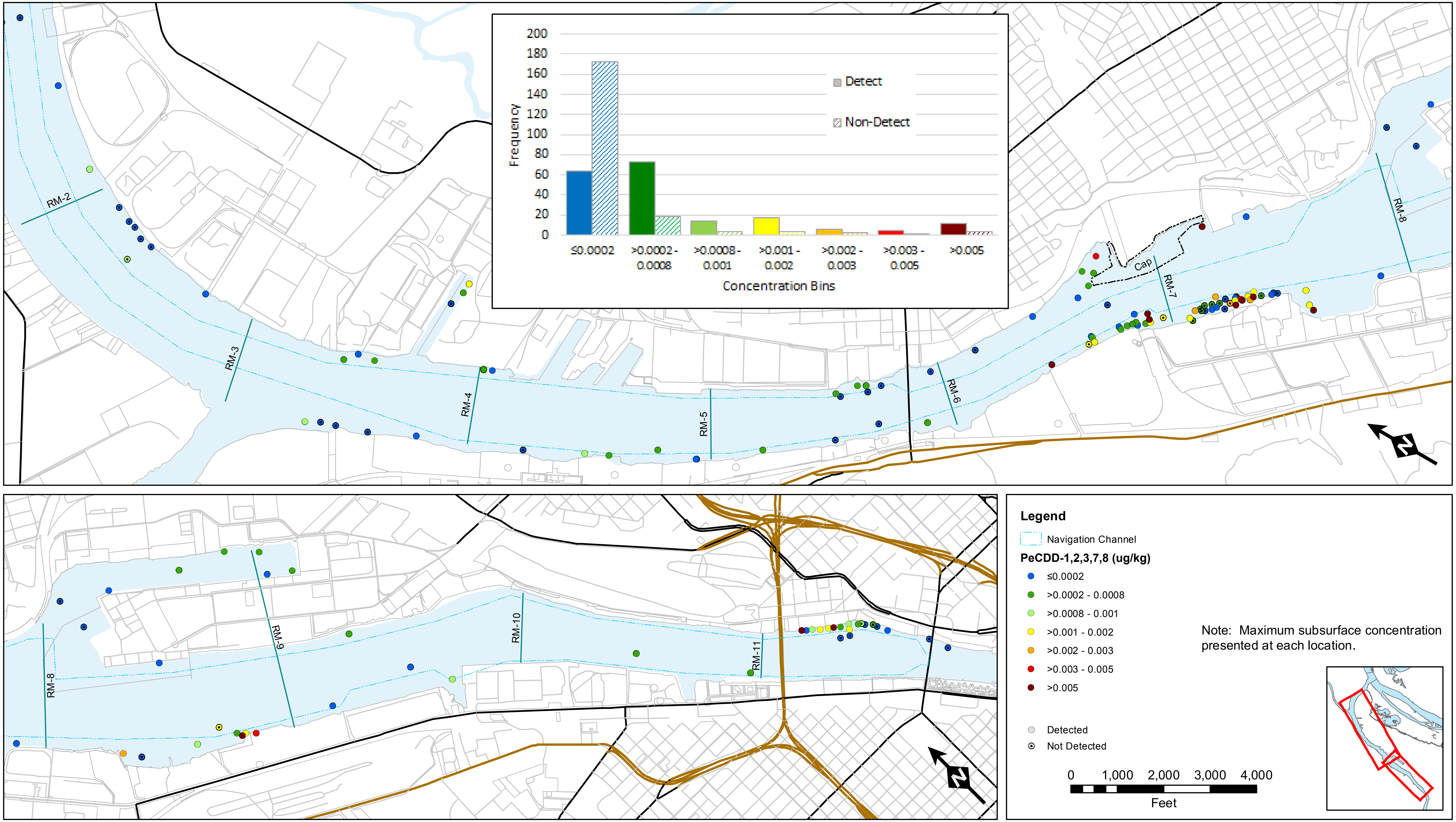

Figure B2-4b. Distribution of Subsurface Sediment Chemistry for 1,2,3,7,8-Pentachlorodibenzo-p-dioxin

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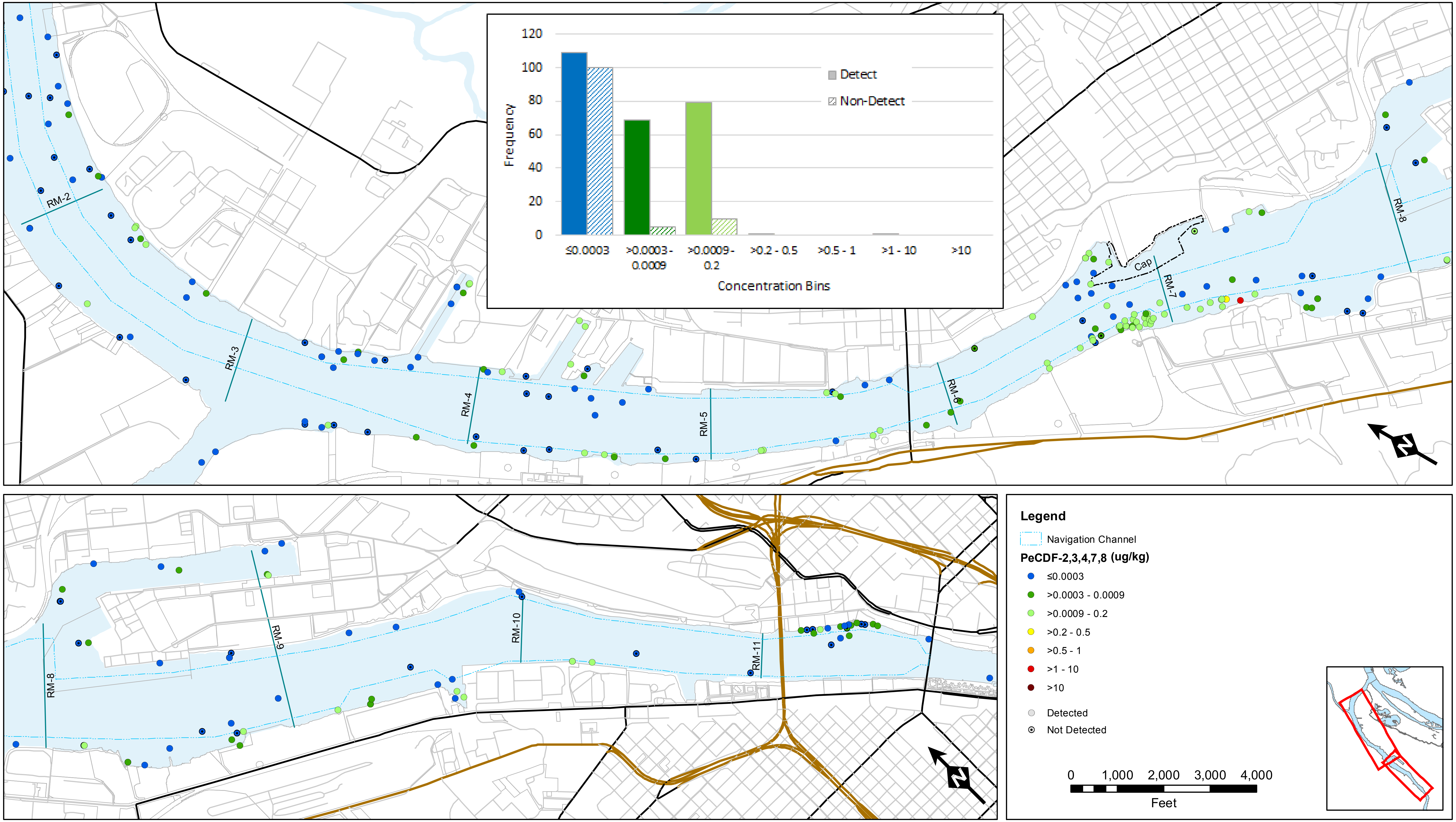

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Figure B2-5a. Distribution of Surface Sediment Chemistry for 2,3,4,7,8-Pentachlorodibenzofuran

Date: 4/19/2016

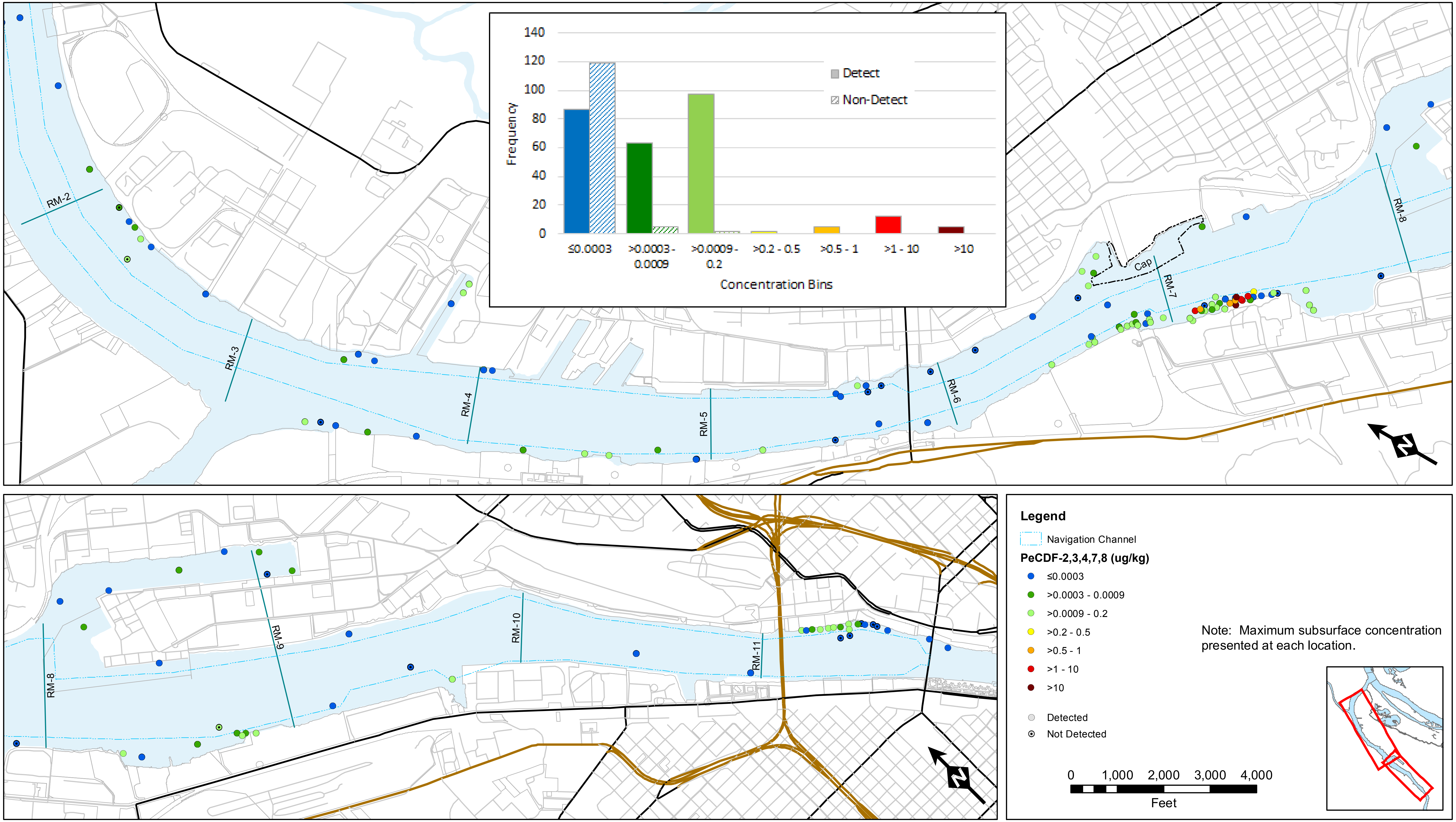

Figure B2-5b. Distribution of Subsurface Sediment Chemistry for 2,3,4,7,8-Pentachlorodibenzofuran

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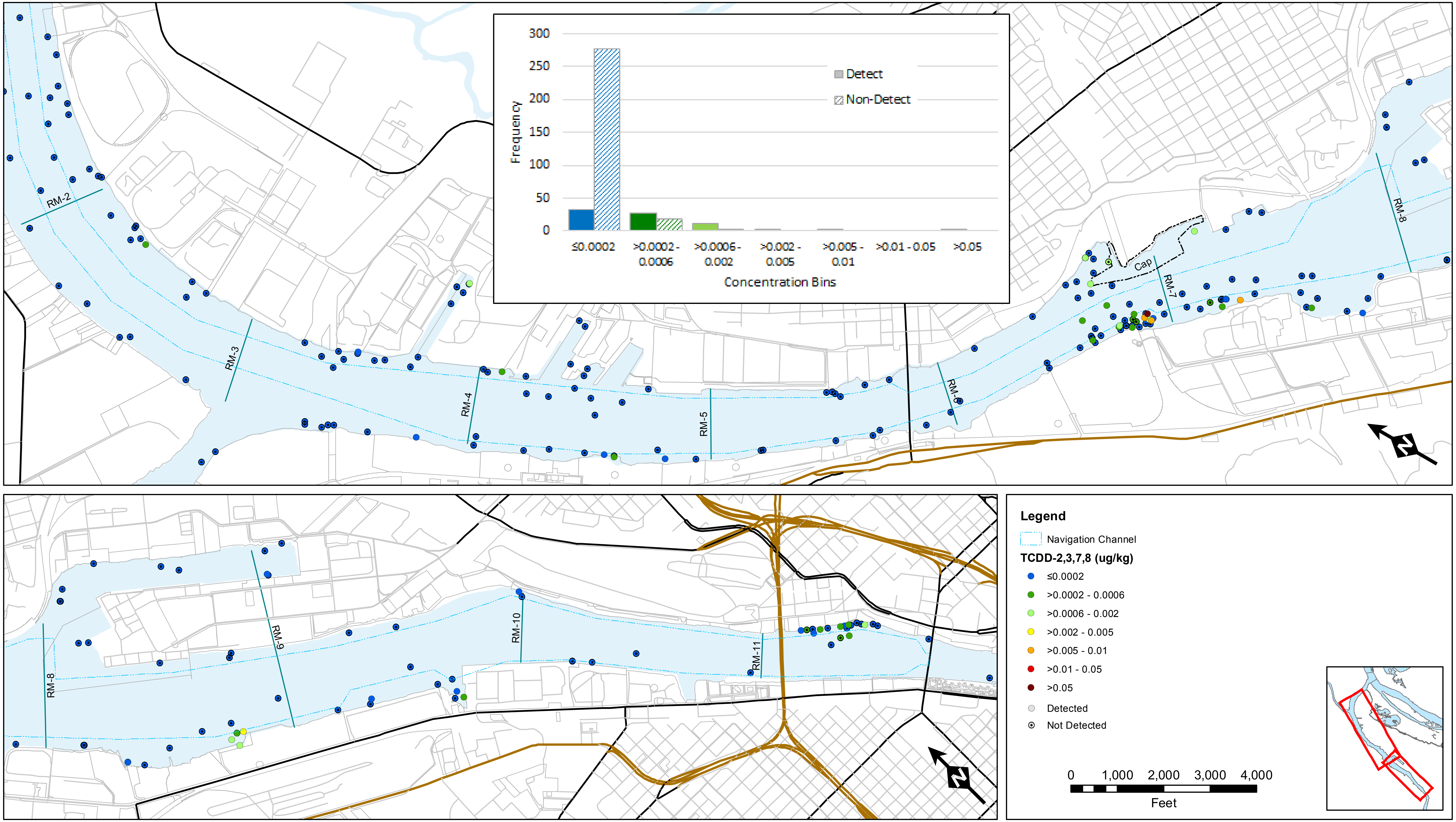

Figure B2-6a. Distribution of Surface Sediment Chemistry for 2,3,7,8-Tetrachlorodibenzo-p-dioxin

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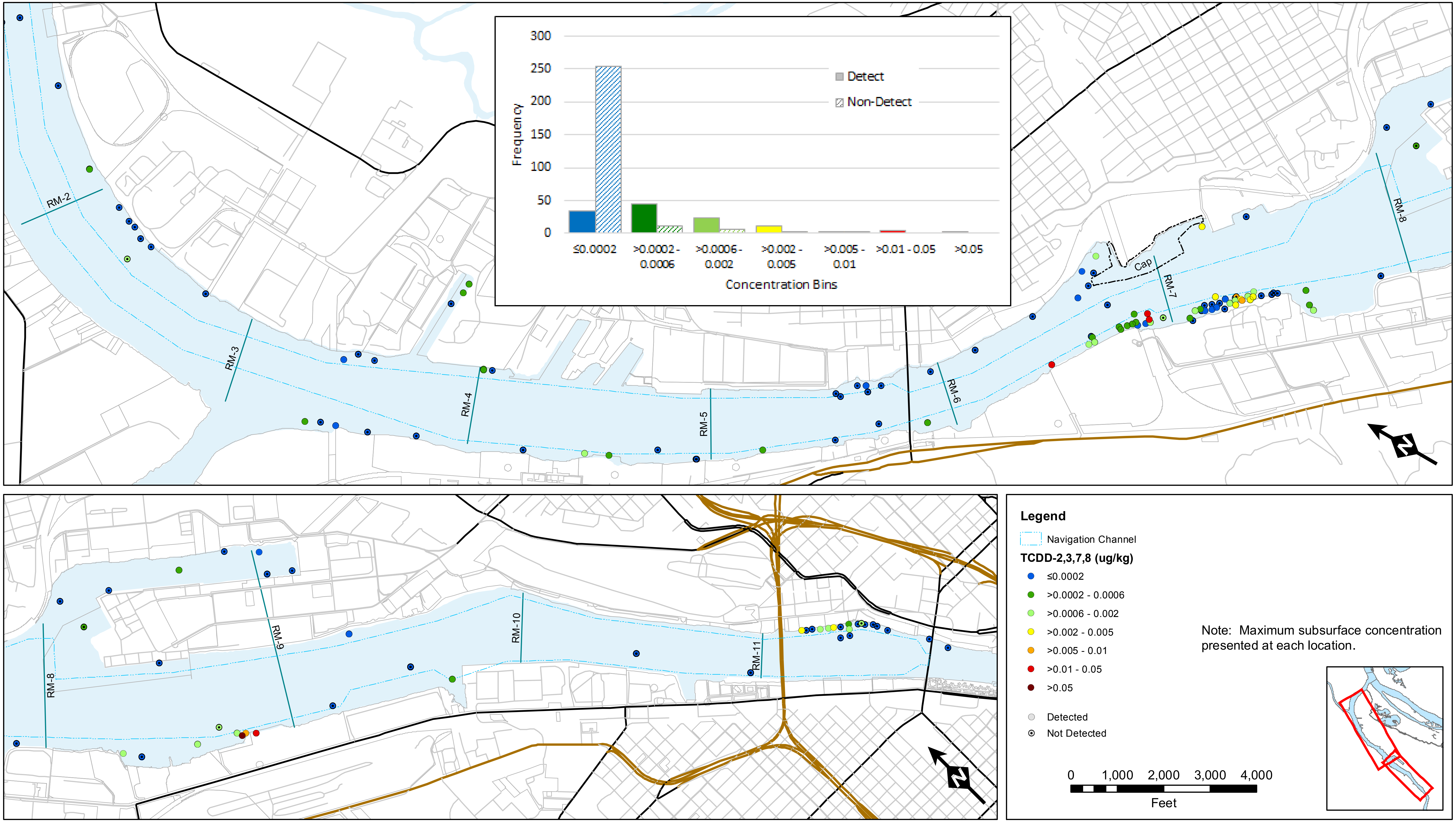

Figure B2-6b. Distribution of Subsurface Sediment Chemistry for 2,3,7,8-Tetrachlorodibenzo-p-dioxin

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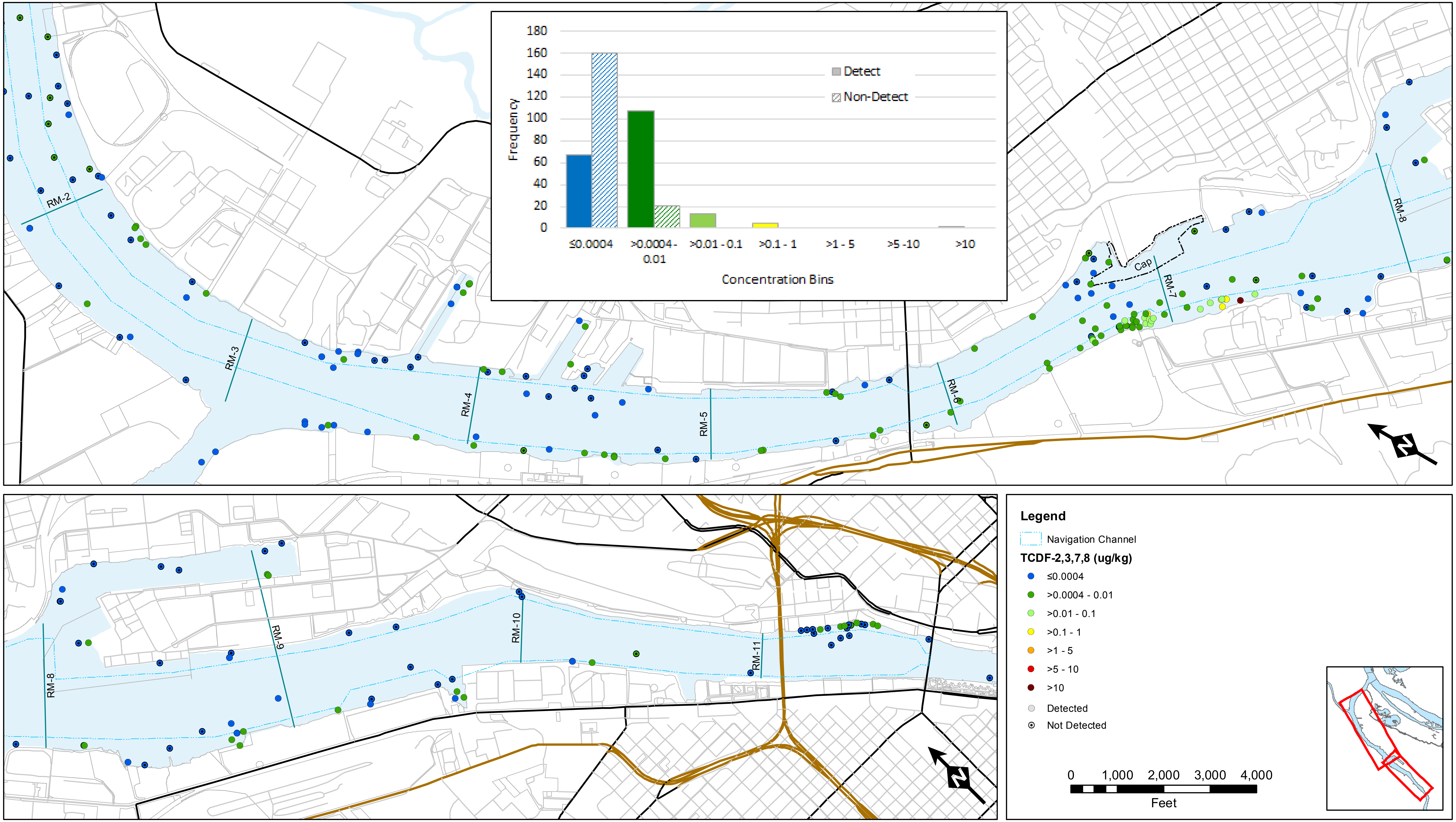

Figure B2-7a. Distribution of Surface Sediment Chemistry for 2,3,7,8-Tetrachlorodibenzofuran

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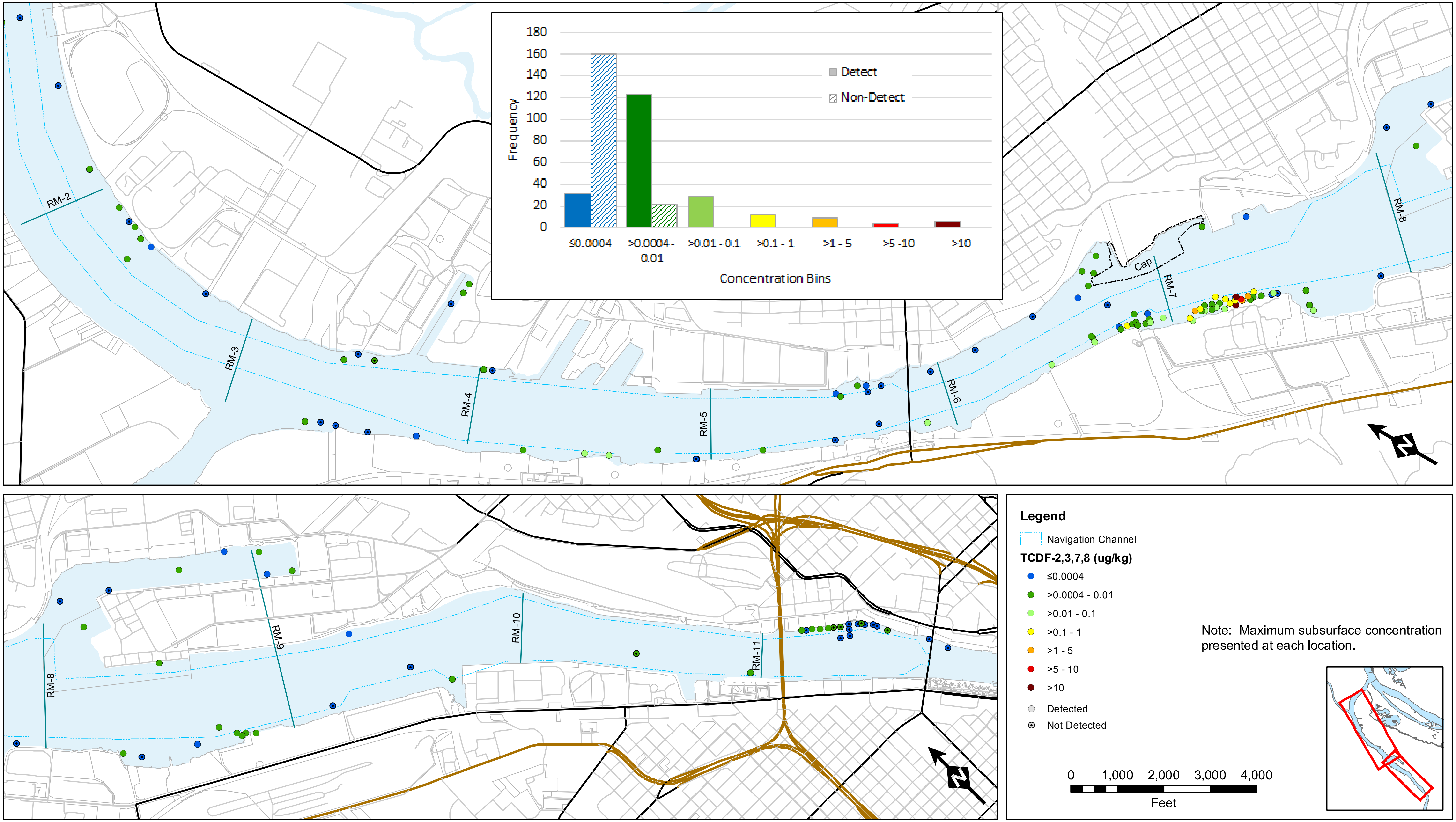

Figure B2-7b. Distribution of Subsurface Sediment Chemistry for 2,3,7,8-Tetrachlorodibenzofuran

Path: E:_Projects\Portland Harbor\GIS\MapDocuments\FS Figures\Appendix B\FigureB2-7b_Subsurface-TCDF.mxd, Created by: MLF

Date: 4/14/2016

ATTACHMENT B2-1
Background Calculations for 1,2,3,4,7,8-HxCDF

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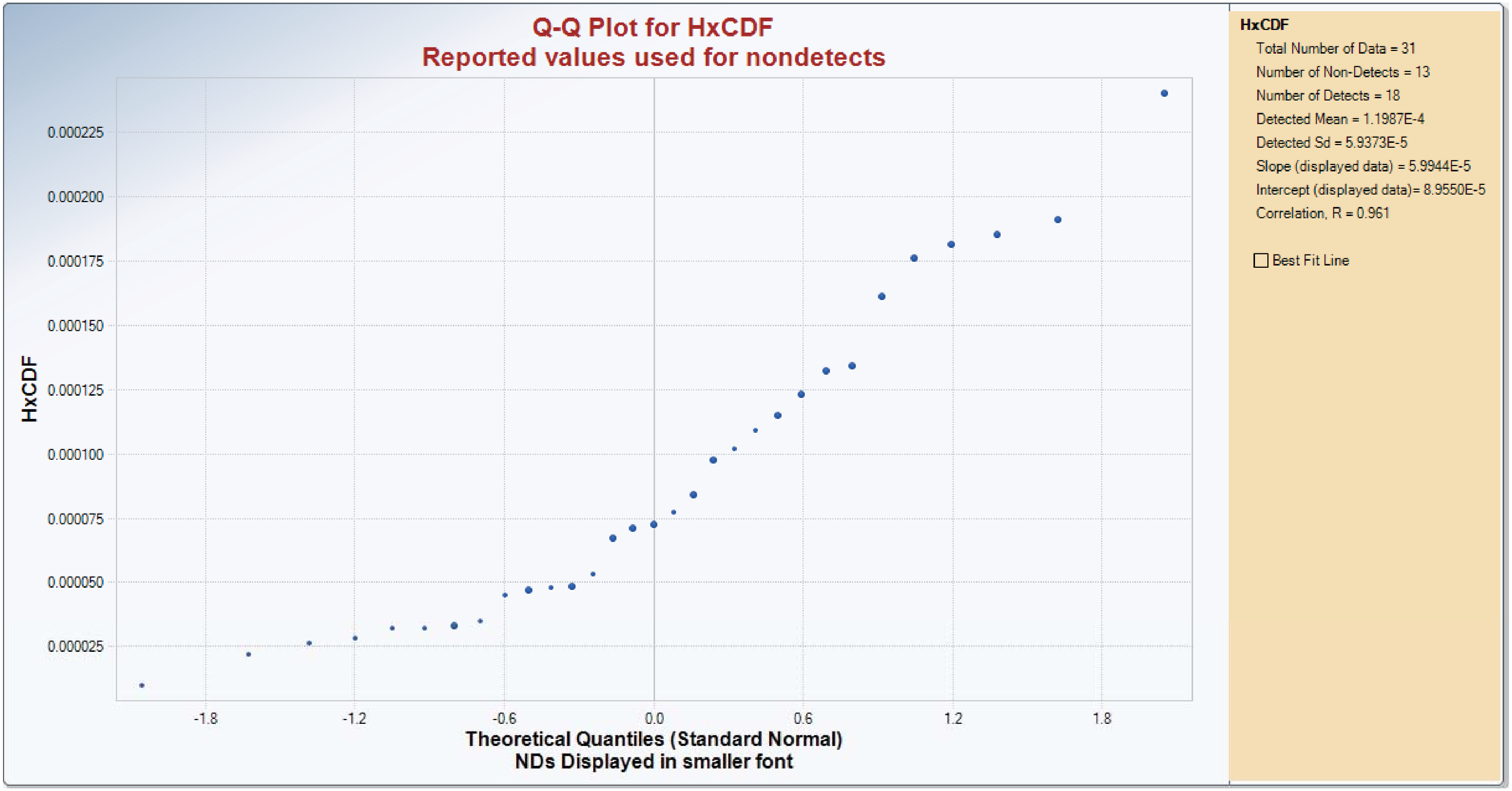
Q-Q Plot for HxCDF
Reported values used for nondetects
0.000225
0.000200
0.000175
0.000150
0.000125
0.000100
0.000075
0.000050
0.000025
HxCDF
-1.8
-1.2
-0.6
0.0
0.6
1.2
1.8
Theoretical Quantiles (Standard Normal)
NDs Displayed in smaller font
HxCDF
Total Number of Data = 31
Number of Non-Detects = 13
Number of Detects = 18
Detected Mean = 1.1987E-4
Detected Sd = 5.9373E-5
Slope (displayed data) = 5.9944E-5
Intercept (displayed data)= 8.9550E-5
Correlation, R = 0.961
Best Fit Line

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	A	B	C	D	E	F	G	H	I	J	K	L
1				Goodness-of-Fit Test Statistics for Data Sets with Non-Detects								
2			User Selected Options									
3			Date/Time of Computation	3/9/2016 12:20:16 PM								
4			From File	WorkSheet.xls								
5			Full Precision	OFF								
6			Confidence Coefficient	0.95								
7												
8												
9	HxCDF											
10												
11					Num Obs	Num Miss	Num Valid	Detects	NDs	% NDs		
12				Raw Statistics	39	0	39	23	16	41.03%		
13												
14					Number	Minimum	Maximum	Mean	Median	SD		
15				Statistics (Non-Detects Only)	16	1.0000E-5	4.4300E-4	7.5813E-5	4.2000E-5	1.0296E-4		
16				Statistics (Detects Only)	23	3.3000E-5	0.00124	2.7135E-4	1.6100E-4	3.3540E-4		
17				Statistics (All: NDs treated as DL value)	39	1.0000E-5	0.00124	1.9113E-4	1.1200E-4	2.8072E-4		
18				Statistics (All: NDs treated as DL/2 value)	39	5.0000E-6	0.00124	1.7558E-4	9.7000E-5	2.8232E-4		
19				Statistics (Normal ROS Imputed Data)	39	-5.391E-4	0.00124	1.4699E-5	8.4000E-5	4.0835E-4		
20				Statistics (Gamma ROS Imputed Data)	39	3.3000E-5	0.01	0.00426	3.4900E-4	0.00485		
21				Statistics (Lognormal ROS Imputed Data)	39	1.5208E-5	0.00124	1.7149E-4	8.4000E-5	2.8265E-4		
22												
23					K hat	K Star	Theta hat	Log Mean	Log Stdv	Log CV		
24				Statistics (Detects Only)	1.244	1.111	2.1807E-4	-8.665	0.888	-0.102		
25				Statistics (NDs = DL)	0.939	0.884	2.0349E-4	-9.182	1.072	-0.117		
26				Statistics (NDs = DL/2)	0.733	0.694	2.3939E-4	-9.466	1.304	-0.138		
27				Statistics (Gamma ROS Estimates)	0.423	0.408	0.0101	--	--	--		
28				Statistics (Lognormal ROS Estimates)	--	--	--	-9.434	1.17	-0.124		
29												
30					Normal GOF Test Results							
31												
32					No NDs	NDs = DL	NDs = DL/2	Normal ROS				
33				Correlation Coefficient R	0.765	0.746	0.737	0.801				
34												
35					Test value	Crit. (0.05)	Conclusion with Alpha(0.05)					
36				Shapiro-Wilk (Detects Only)	0.592	0.914	Data Not Normal					
37				Lilliefors (Detects Only)	0.377	0.185	Data Not Normal					
38				Shapiro-Wilk (NDs = DL)	0.57	0.939	Data Not Normal					
39				Lilliefors (NDs = DL)	0.346	0.142	Data Not Normal					
40				Shapiro-Wilk (NDs = DL/2)	0.557	0.939	Data Not Normal					
41				Lilliefors (NDs = DL/2)	0.324	0.142	Data Not Normal					
42				Shapiro-Wilk (Normal ROS Estimates)	0.842	0.939	Data Not Normal					
43				Lilliefors (Normal ROS Estimates)	0.205	0.142	Data Not Normal					
44												
45					Gamma GOF Test Results							
46												
47					No NDs	NDs = DL	NDs = DL/2	Gamma ROS				
48				Correlation Coefficient R	0.909	0.922	0.924	0.683				
49												
50					Test value	Crit. (0.05)	Conclusion with Alpha(0.05)					
51				Anderson-Darling (Detects Only)	2.082	0.765						
52				Kolmogorov-Smirnov (Detects Only)	0.307	0.186	Data Not Gamma Distributed					

	A	B	C	D	E	F	G	H	I	J	K	L
53	Anderson-Darling (NDs = DL)				1.707	0.781						
54	Kolmogorov-Smirnov (NDs = DL)				0.21	0.146	Data Not Gamma Distributed					
55	Anderson-Darling (NDs = DL/2)				1.304	0.79						
56	Kolmogorov-Smirnov (NDs = DL/2)				0.167	0.147	Data Not Gamma Distributed					
57	Anderson-Darling (Gamma ROS Estimates)				4.496	0.83						
58	Kolmogorov-Smirnov (Gamma ROS Est.)				0.281	0.151	Data Not Gamma Distributed					
59												
60	**Lognormal GOF Test Results**											
61												
62					No NDs	NDs = DL	NDs = DL/2	Log ROS				
63	Correlation Coefficient R				0.944	0.982	0.984	0.957				
64												
65					Test value	Crit. (0.05)	Conclusion with Alpha(0.05)					
66	Shapiro-Wilk (Detects Only)				0.895	0.914	Data Not Lognormal					
67	Lilliefors (Detects Only)				0.237	0.185	Data Not Lognormal					
68	Shapiro-Wilk (NDs = DL)				0.962	0.939	Data Appear Lognormal					
69	Lilliefors (NDs = DL)				0.128	0.142	Data Appear Lognormal					
70	Shapiro-Wilk (NDs = DL/2)				0.962	0.939	Data Appear Lognormal					
71	Lilliefors (NDs = DL/2)				0.106	0.142	Data Appear Lognormal					
72	Shapiro-Wilk (Lognormal ROS Estimates)				0.903	0.939	Data Not Lognormal					
73	Lilliefors (Lognormal ROS Estimates)				0.186	0.142	Data Not Lognormal					
74	**Note: Substitution methods such as DL or DL/2 are not recommended.**											

Outlier Tests for Selected Variables replacing nondetects with 1/2 the Detection Limit

User Selected Options	
Date/Time of Computation	10/22/2015 2:47:57 PM
From File	WorkSheet.xls
Full Precision	OFF

Rosner's Outlier Test for 10 Outliers in HxCDF

Total N	**31**
Number NDs	**13**
Number Detects	**31**
Mean with NDs=DL/2	**7.9577E-5**
SD with NDs=DL/2	**6.6441E-5**
Number of data	**31**
Number of suspected outliers	**10**
NDs replaced with half value.	

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	7.9577E-5	6.5360E-5	2.4000E-4	24	2.454	2.92	3.25
2	7.4229E-5	6.0412E-5	1.9100E-4	18	1.933	2.91	3.24
3	7.0203E-5	5.7238E-5	1.8500E-4	27	2.006	2.89	3.22
4	6.6103E-5	5.3777E-5	1.8100E-4	30	2.137	2.88	3.2
5	6.1847E-5	4.9766E-5	1.7600E-4	28	2.294	2.86	3.18
6	5.7457E-5	4.5105E-5	1.6100E-4	26	2.296	2.84	3.156
7	5.3315E-5	4.0677E-5	1.3400E-4	19	1.984	2.82	3.132
8	4.9953E-5	3.7838E-5	1.3200E-4	22	2.168	2.8	3.108
9	4.6386E-5	3.4315E-5	1.2300E-4	20	2.233	2.78	3.084
10	4.2904E-5	3.0681E-5	1.1500E-4	10	2.35	2.76	3.06

For 5% Significance Level, there is no Potential Outlier

For 1% Significance Level, there is no Potential Outlier

1		Background Statistics for Data Sets with Non-Detects		
2	User Selected Options			
3	Date/Time of Computation	10/22/2015 2:50:45 PM		
4	From File	WorkSheet.xls		
5	Full Precision	OFF		
6	Confidence Coefficient	95%		
7	Coverage	95%		
8	Different or Future K Observations	1		
9	Number of Bootstrap Operations	2000		
10				
11	HxCDF			
12				
13	General Statistics			
14	Total Number of Observations	31	Number of Missing Observations	0
15	Number of Distinct Observations	30		
16	Number of Detects	18	Number of Non-Detects	13
17	Number of Distinct Detects	18	Number of Distinct Non-Detects	12
18	Minimum Detect	3.3000E-5	Minimum Non-Detect	9.7600E-6
19	Maximum Detect	2.4000E-4	Maximum Non-Detect	1.0900E-4
20	Variance Detected	3.5251E-9	Percent Non-Detects	41.94%
21	Mean Detected	1.1987E-4	SD Detected	5.9373E-5
22	Mean of Detected Logged Data	-9.164	SD of Detected Logged Data	0.563
23				
24	Critical Values for Background Threshold Values (BTVs)			
25	Tolerance Factor K (For UTL)	2.197	d2max (for USL)	2.76
26				
27	Normal GOF Test on Detects Only			
28	Shapiro Wilk Test Statistic	0.956	Shapiro Wilk GOF Test	
29	5% Shapiro Wilk Critical Value	0.897	Detected Data appear Normal at 5% Significance Level	
30	Lilliefors Test Statistic	0.122	Lilliefors GOF Test	
31	5% Lilliefors Critical Value	0.209	Detected Data appear Normal at 5% Significance Level	
32	Detected Data appear Normal at 5% Significance Level			
33				
34	Kaplan Meier (KM) Background Statistics Assuming Normal Distribution			
35	Mean	7.6680E-5	SD	6.8161E-5
36	95% UTL95% Coverage	2.2643E-4	95% KM UPL (t)	1.9422E-4
37	90% KM Percentile (z)	1.6403E-4	95% KM Percentile (z)	1.8880E-4
38	99% KM Percentile (z)	2.3525E-4	95% KM USL	2.6477E-4
39				
40	DL/2 Substitution Background Statistics Assuming Normal Distribution			
41	Mean	7.9577E-5	SD	6.6441E-5
42	95% UTL95% Coverage	2.2555E-4	95% UPL (t)	1.9415E-4
43	90% Percentile (z)	1.6472E-4	95% Percentile (z)	1.8886E-4
44	99% Percentile (z)	2.3414E-4	95% USL	2.6292E-4
45	DL/2 is not a recommended method. DL/2 provided for comparisons and historical reasons			
46				
47	Gamma GOF Tests on Detected Observations Only			
48	A-D Test Statistic	0.295	Anderson-Darling GOF Test	
49	5% A-D Critical Value	0.743	Detected data appear Gamma Distributed at 5% Significance Level	
50	K-S Test Statistic	0.114	Kolmogrov-Smirnoff GOF	
51	5% K-S Critical Value	0.205	Detected data appear Gamma Distributed at 5% Significance Level	
52	Detected data appear Gamma Distributed at 5% Significance Level			

	A	B	C	D	E	F	G	H	I	J	K	L
53												
54	**Gamma Statistics on Detected Data Only**											
55					k hat (MLE)	3.854					k star (bias corrected MLE)	3.248
56					Theta hat (MLE)	3.1106E-5					Theta star (bias corrected MLE)	3.6902E-5
57					nu hat (MLE)	138.7					nu star (bias corrected)	116.9
58					MLE Mean (bias corrected)	1.1987E-4						
59					MLE Sd (bias corrected)	6.6509E-5					95% Percentile of Chisquare (2k)	13.33
60												
61	**Gamma ROS Statistics using Imputed Non-Detects**											
62	GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs											
63	GROS may not be used when kstar of detected data is small such as < 0.1											
64	For such situations, GROS method tends to yield inflated values of UCLs and BTVs											
65	For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates											
66					Minimum	3.3000E-5					Mean	0.00426
67					Maximum	0.01					Median	1.8500E-4
68					SD	0.00496					CV	1.163
69					k hat (MLE)	0.371					k star (bias corrected MLE)	0.357
70					Theta hat (MLE)	0.0115					Theta star (bias corrected MLE)	0.012
71					nu hat (MLE)	23.01					nu star (bias corrected)	22.12
72					MLE Mean (bias corrected)	0.00426					MLE Sd (bias corrected)	0.00714
73					95% Percentile of Chisquare (2k)	3.083					90% Percentile	0.0123
74					95% Percentile	0.0184					99% Percentile	0.0341
75	**The following statistics are computed using Gamma ROS Statistics on Imputed Data**											
76	**Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods**											
77					WH	HW					WH	HW
78				95% Approx. Gamma UTL with 95% Coverage	0.0279	0.0339				95% Approx. Gamma UPL	0.0183	0.0204
79				95% Gamma USL	0.0432	0.0575						
80												
81	**The following statistics are computed using gamma distribution and KM estimates**											
82	**Upper Limits using Wilson Hilferty (WH) and Hawkins Wixley (HW) Methods**											
83					k hat (KM)	1.266					nu hat (KM)	78.47
84					WH	HW					WH	HW
85				95% Approx. Gamma UTL with 95% Coverage	3.2255E-4	3.5618E-4				95% Approx. Gamma UPL	2.3802E-4	2.5241E-4
86				95% Gamma USL	4.4670E-4	5.1801E-4						
87												
88	**Lognormal GOF Test on Detected Observations Only**											
89					Shapiro Wilk Test Statistic	0.952	**Shapiro Wilk GOF Test**					
90					5% Shapiro Wilk Critical Value	0.897	Detected Data appear Lognormal at 5% Significance Level					
91					Lilliefors Test Statistic	0.122	**Lilliefors GOF Test**					
92					5% Lilliefors Critical Value	0.209	Detected Data appear Lognormal at 5% Significance Level					
93	**Detected Data appear Lognormal at 5% Significance Level**											
94												
95	**Background Lognormal ROS Statistics Assuming Lognormal Distribution Using Imputed Non-Detects**											
96					Mean in Original Scale	8.2821E-5					Mean in Log Scale	-9.676
97					SD in Original Scale	6.3071E-5					SD in Log Scale	0.754
98					95% UTL95% Coverage	3.2951E-4					95% BCA UTL95% Coverage	2.4000E-4
99					95% Bootstrap (%) UTL95% Coverage	2.4000E-4					95% UPL (t)	2.3067E-4
100					90% Percentile (z)	1.6515E-4					95% Percentile (z)	2.1723E-4
101					99% Percentile (z)	3.6326E-4					95% USL	5.0368E-4
102												
103	**Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution**											
104					KM Mean of Logged Data	-10.05					95% KM UTL (Lognormal)95% Coverage	5.8898E-4

	A-E	F	G-K	L
105	KM SD of Logged Data	1.187	95% KM UPL (Lognormal)	3.3606E-4
106	95% KM Percentile Lognormal (z)	3.0577E-4	95% KM USL (Lognormal)	0.00115
107				
108	**Background DL/2 Statistics Assuming Lognormal Distribution**			
109	Mean in Original Scale	7.9577E-5	Mean in Log Scale	-9.866
110	SD in Original Scale	6.6441E-5	SD in Log Scale	1.028
111	95% UTL95% Coverage	4.9745E-4	95% UPL (t)	3.0594E-4
112	90% Percentile (z)	1.9401E-4	95% Percentile (z)	2.8190E-4
113	99% Percentile (z)	5.6819E-4	95% USL	8.8711E-4
114	**DL/2 is not a Recommended Method. DL/2 provided for comparisons and historical reasons.**			
115				
116	**Nonparametric Distribution Free Background Statistics**			
117	**Data appear to follow a Discernible Distribution at 5% Significance Level**			
118				
119	**Nonparametric Upper Limits for BTVs(no distinction made between detects and nondetects)**			
120	Order of Statistic, r	31	95% UTL with95% Coverage	2.4000E-4
121	Approximate f	1.632	Confidence Coefficient (CC) achieved by UTL	0.796
122	95% UPL	2.1060E-4	95% USL	2.4000E-4
123	95% KM Chebyshev UPL	3.7854E-4		
124				
125	Note: The use of USL to estimate a BTV is recommended only when the data set represents a background			
126	data set free of outliers and consists of observations collected from clean unimpacted locations.			
127	The use of USL tends to provide a balance between false positives and false negatives provided the data			
128	represents a background data set and when many onsite observations need to be compared with the BTV.			
129				

UCL Statistics for Data Sets with Non-Detects			
User Selected Options			
Date/Time of Computation	3/9/2016 11:25:18 AM		
From File	WorkSheet.xls		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

HxCDF

General Statistics			
Total Number of Observations	39	Number of Distinct Observations	36
Number of Detects	23	Number of Non-Detects	16
Number of Distinct Detects	22	Number of Distinct Non-Detects	15
Minimum Detect	3.3000E-5	Minimum Non-Detect	1.0000E-5
Maximum Detect	0.00124	Maximum Non-Detect	4.4300E-4
Variance Detects	1.1249E-7	Percent Non-Detects	41.03%
Mean Detects	2.7135E-4	SD Detects	3.3540E-4
Median Detects	1.6100E-4	CV Detects	1.236
Skewness Detects	2.249	Kurtosis Detects	3.856
Mean of Logged Detects	-8.665	SD of Logged Detects	0.888

Normal GOF Test on Detects Only		
Shapiro Wilk Test Statistic	0.592	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.914	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.377	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.185	Detected Data Not Normal at 5% Significance Level
Detected Data Not Normal at 5% Significance Level		

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs			
Mean	1.6838E-4	Standard Error of Mean	4.6141E-5
SD	2.8128E-4	95% KM (BCA) UCL	2.5692E-4
95% KM (t) UCL	2.4617E-4	95% KM (Percentile Bootstrap) UCL	2.4804E-4
95% KM (z) UCL	2.4428E-4	95% KM Bootstrap t UCL	2.9404E-4
90% KM Chebyshev UCL	3.0681E-4	95% KM Chebyshev UCL	3.6951E-4
97.5% KM Chebyshev UCL	4.5654E-4	99% KM Chebyshev UCL	6.2748E-4

Gamma GOF Tests on Detected Observations Only		
A-D Test Statistic	2.082	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.765	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.307	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.186	Detected Data Not Gamma Distributed at 5% Significance Level
Detected Data Not Gamma Distributed at 5% Significance Level		

Gamma Statistics on Detected Data Only			
k hat (MLE)	1.244	k star (bias corrected MLE)	1.111
Theta hat (MLE)	2.1807E-4	Theta star (bias corrected MLE)	2.4424E-4
nu hat (MLE)	57.24	nu star (bias corrected)	51.11
MLE Mean (bias corrected)	2.7135E-4	MLE Sd (bias corrected)	2.5744E-4

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.358	nu hat (KM)	27.95
Approximate Chi Square Value (27.95, α)	16.89	Adjusted Chi Square Value (27.95, β)	16.55
95% Gamma Approximate KM-UCL (use when n>=50)	2.7865E-4	95% Gamma Adjusted KM-UCL (use when n<50)	2.8437E-4
Gamma ROS Statistics using Imputed Non-Detects			
GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs			
GROS may not be used when kstar of detected data is small such as < 0.1			
For such situations, GROS method tends to yield inflated values of UCLs and BTVs			
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates			
Minimum	3.3000E-5	Mean	0.00426
Maximum	0.01	Median	3.4900E-4
SD	0.00485	CV	1.139
k hat (MLE)	0.423	k star (bias corrected MLE)	0.408
Theta hat (MLE)	0.0101	Theta star (bias corrected MLE)	0.0105
nu hat (MLE)	33	nu star (bias corrected)	31.79
MLE Mean (bias corrected)	0.00426	MLE Sd (bias corrected)	0.00668
		Adjusted Level of Significance (β)	0.0437
Approximate Chi Square Value (31.79, α)	19.91	Adjusted Chi Square Value (31.79, β)	19.54
95% Gamma Approximate UCL (use when n>=50)	0.00681	95% Gamma Adjusted UCL (use when n<50)	0.00694
Lognormal GOF Test on Detected Observations Only			
Shapiro Wilk Test Statistic	0.895	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.914	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.237	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.185	Detected Data Not Lognormal at 5% Significance Level	
Detected Data Not Lognormal at 5% Significance Level			
Lognormal ROS Statistics Using Imputed Non-Detects			
Mean in Original Scale	1.7149E-4	Mean in Log Scale	-9.434
SD in Original Scale	2.8265E-4	SD in Log Scale	1.17
95% t UCL (assumes normality of ROS data)	2.4780E-4	95% Percentile Bootstrap UCL	2.5449E-4
95% BCA Bootstrap UCL	2.7698E-4	95% Bootstrap t UCL	2.9318E-4
95% H-UCL (Log ROS)	2.5987E-4		
DL/2 Statistics			
DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.7558E-4	Mean in Log Scale	-9.466
SD in Original Scale	2.8232E-4	SD in Log Scale	1.304
95% t UCL (Assumes normality)	2.5179E-4	95% H-Stat UCL	3.2620E-4
DL/2 is not a recommended method, provided for comparisons and historical reasons			
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution at 5% Significance Level			
Suggested UCL to Use			
95% KM (t) UCL	2.4617E-4	95% KM (% Bootstrap) UCL	2.4804E-4
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
Recommendations are based upon data size, data distribution, and skewness.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.			